OPERATION AND MAINTENANCE MANUAL

NAV-750

ifr INC

NAV-750

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SECTION I

General Information

1-1. NAV-750 Description.

1-2. The NAV-750 is a precision simulator of VOR, LOC, G/S and COMM ground stations. It is completely self-contained and no other equipment is necessary for full operation. However, the NAV-750 may be externally controlled to change output frequencies, or it can remotely channel a receiver with a two out of five select system.

1-3. The VOR section provides bearings every 30° with plus or minus 10 degree steps by push button switches. From any heading the bearing can be indefinitely varied in.01 or .05 degree steps. All VOR frequencies are provided with calibrated, variable output.

1-4. The LOC and G/S sections use precision 90 and 150Hz tone generators accurately mixed to provide "on-course" and certain specified deviations. All LOC and G/S frequencies are available with calibrated output.

1-5. COMM receiver testing is accomplished by an RF generator with all frequencies from 118.00 to 156.00 MHz available in 25 kHz steps. A 1020Hz tone may be added.

1-6. In all modes, the RF generator is crystal-controlled and phase-locked in 25 kHz steps, if desired. Automatic frequency stepping at a variable rate is provided, selectable in 25, 50, 100, or 200 kHz intervals.

1-7. WARRANTY. (See following page)

WARRANTY AND SERVICE INSTRUCTIONS

A. Warranty.

B. IFR, Inc., warrants that each new instrument manufactured by it is free from defects in material or workmanship under normal use and service for a period of two years from the shipping date. (NOTE: 90 day warranty on battery pack). Each instrument is functionally tested immediately prior to shipment. If, upon examination by IFR, the instrument is determined to be defective in workmanship or material, IFR will, subject to the conditions set forth below, either repair the defective part or replace it with a new part on a pro rata basis. IFR shall not be liable for any delay or failure to furnish a replacement part resulting directly or indirectly from any governmental restriction, priority or allocation or any other governmental regulatory order or action, nor shall IFR be liable for damages by reason of the failure of the instrument to perform properly or for any consequential damages. The warranty does not apply to any instrument that has been subject to negligence, accident, shipping damage, misuse or improper installation or operation, or that in any way has been tampered with, altered or repaired by any person other than an authorized IFR service organization or any employee thereof, or to any instrument whose serial number has been altered, defaced or removed, or to any instrument purchased within, and thereafter removed beyond, the continental limits of the United States. Annual recalibration is not included in warranty.

C. All sales are FOB IFR Factory, Wichita. IFR will assume responsibility for freight charges on all legitimate warranty claims within thirty (30) days from the original shipping date. All legitimate warranty claims within thirty (30) to ninety (90) days should be shipped to IFR freight collect and will be returned freight collect. All freight on warranty claims after ninety (90) days will be paid by the customer.

D. This warranty shall, at IFR's option, become void if the equipment ownership is changed, unless the prior owner or the proposed owner obtains approval of continuation of the warranty prior to the change of ownership.

E. This warranty is in lieu of all other warranties, expressed or implied, and no one is authorized to assume any liability on behalf of IFR or impose any obligation upon it in connectioon with the sale of any instrument, other than as stated above.

F. Changes in Specifications.

G. The right is reserved to change the published specifications of the equipment at any time and to furnish merchandise in

accordance with current specifications without incurring any liability to modify equipment previously sold, or to supply new equipment in accordance with earlier specifications except the classification of special apparatus.

H. Service.

I. When requesting service, the originator shall give IFR information concerning the nature of the failure and the manner in which the equipment was used when the failure occurred. Type, model, and serial number should also be provided.

J. Do not return any products to the factory without first receiving authorization from the factory Customer Service Department.

CONTACT:

IFR, Inc.
4053 Navajo Lane
Wichita, Kansas 67210 USA

ATTN: Customer Service Department

PHONE: (800) 835-2350 (Customer Service Only)

TWX: 910-741-6952

K. Unless otherwise specifically requested, packaging for a return shipment shall be in the original container and packaging material. If the original container and material are not available, information as to suitable packaging techniques will be provided by the IFR Shipping Department.

L. Returned material claimed defective, but found to meet all previously applicable specifications, will be subject to a minimum evaluation charge consisting of the labor charges involved in the status determination of the material.

M. Returned material not accompanied by statement of claimed defects may be returned at the originator's expense.

N. Any departure from the above instructions without specific factory authorization can be considered a breach of warranty, and all expenses incurred as a result will be billed to the originator.

Spectral Purity

Harmonics (With -30 dBm RF output attenuator setting)

Greater than 30dB below carrier level at any selected frequency.

Close-In Noise

108.0 MHz - greater than 74dB below carrier level at ±20 kHz.

334.7 MHz - greater than 68dB below carrier level at ±40 kHz.

Nonharmonic Spurious Noise (The phase-lock control frequency in in the NAV-750 is 12.5 kHz)

±12.5 kHz - 68dB below carrier level
±20.0 kHz - 74dB below carrier level
±25.0 kHz - 71dB below carrier level

Level below carrier stated in a 300Hz bandwidth.

(Above levels observed with a carrier frequency of 108.0 MHz and a carrier level of -30 dBm)

Broadband Noise

Greater than 80 dB below carrier level at selected frequencies ±50 kHz or greater away from the carrier frequency.

Residual FM

(Post-detection noise bandwidth - 20Hz to 15 kHz)

108.0 MHz - ± 200Hz P-P or less
334.7 MHz - ± 400Hz P-P or less

Spectral Purity

Harmonics (With -30 dBm RF output attenuator setting)

Greater than 30dB below carrier level at any selected frequency.

Close-In Noise

108.0 MHz - greater than 78dB below carrier level at ±15 kHz.

334.7 MHz - greater than 74dB below carrier level at ±40 kHz.

Nonharmonic Spurious Noise (The phase-lock control frequency in the NAV-750A is 12.5 kHz.)

±12.5 kHz - 75dB below carrier level
±15.0 kHz - 78dB below carrier level
±25.0 kHz - 83dB below carrier level

Level below carrier stated in a 300Hz bandwidth.

(Above levels observed with a carrier frequency of 108.0 MHz and a carrier level of -30 dBm)

Broadband Noise

Greater than 80dB below carrier level at selected frequencies ±50 kHz or greater away from the carrier frequency.

Residual FM

(Post-detection noise bandwidth - 20Hz to 15 kHz)

108.0 MHz - ±200Hz P-P or less
334.7 MHz - ±400Hz P-P or less

NAV-750
RF SPECTRUM

NAV-750 RF Output	-20 dBm
NAV-750 RF Frequency	108 MHz

SPECTRUM ANALYZER SETTINGS

Log Ref Level	-30
Scan Width	5 kHz

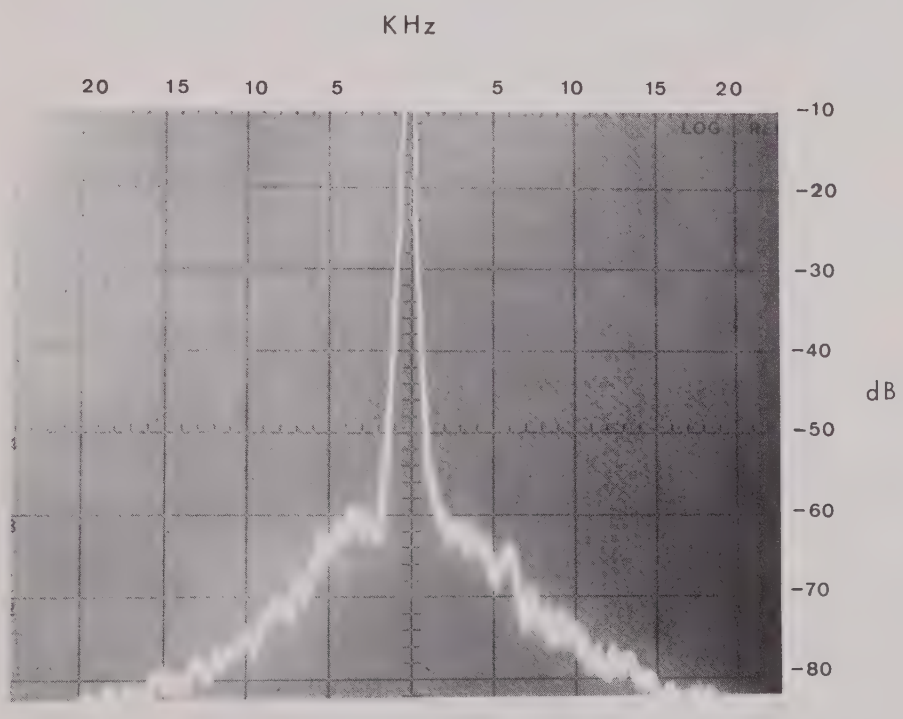


FIGURE 1-1

Input Attenuation	0
Bandwidth	300Hz
Scale	10dB Log
Scan Time	2 sec
Video Filter	10Hz

SPECIFICATIONS

NAV-750
(Without Option A)

RF Power Out:

Accuracy:	±1.5dB to -50 dBm ±2.5dB from -50 dBm to -120 dBm
Leakage: (With all unused outputs properly terminated)	Less than 3uV induced in a two-turn, one inch diameter (#20 ga wire) loop, measured one inch away from any surface and into a 50 ohm receiver.

Modulation:

AM Depth:	0-98%
Absolute Accuracy: (Reading front panel meter)	1.0% at 20% modulation 1.5% at 30% modulation 2.0% at 40% modulation

Spectral Purity:

Harmonics:	Greater than 30dB below carrier level at any selected frequency.
Noise: (Level below carrier stated in a 300Hz bandwidth)	108.0 MHz - greater than 74dB below carrier level at ±20 kHz. 334.7 MHz - greater than 68dB below carrier level at ± 40 kHz.
Residual FM: (Post-detection noise bandwidth 20Hz-15 kHz)	108.0 MHz - less than ± 200Hz P-P 334.7 MHz - less than ± 400Hz P-P

Internal Reference Oven Xtal:

Aging:	Less than ± 2ppm/yr
Generator Frequency	Better than ± 1ppm for 15° to 35°C
Accuracy: (After calibration at 25°C)	Better than ± 3ppm for 10° to 45°C

Section II

SPECIFICATIONS

NAV-750A

RF Power Out:

Accuracy:	± 1.5 dB to -50 dBm ± 2.5 dB from -50 dBm to -120 dBm
Leakage: (With all unused outputs properly terminated)	Less than 3uV induced in a two-turn, one inch diameter (#20 ga wire) loop, measured one inch away from any surface and into a 50 ohm receiver.

Modulation:

AM Depth:	0-98%
Absolute Accuracy: (Reading front panel meter)	1.0% at 20% modulation 1.5% at 30% modulation 2.0% at 40% modulation

Spectral Purity:

Harmonics:	Greater than 30 dB below carrier level at any selected frequency
Noise: (Level below carrier stated in a 300Hz bandwidth)	108.0 MHz - greater than 78 dB below carrier level at ± 15 kHz. 334.7 MHz - greater than 74 dB below carrier level at ± 40 kHz.
Residual FM: (Post-detection noise bandwidth -- 20Hz-15 KHz)	108.0 MHz - less than ± 200Hz P-P 334.7 MHz - less than ± 400Hz P-P

Internal Reference Oven Xtal:

Aging:	Less than ± 2ppm/yr
Generator Frequency Accuracy: (After calibration at 25°C)	Better than ± 1ppm for 15° to 35°C Better than ± 3ppm for 10° to 45°C

DDM ACCURACY AT POSITIONS OTHER THAN CENTERING

COMPOSTE AUDIO ERROR = Centering Error + 1.5% DDM Setting

$$\text{PERCENTAGE OF MODULATION ERROR} = \text{DDM Setting X } \frac{\left(\begin{array}{c}\text{measured, single-}\\ \text{tone, \% of modu-}\\ \text{lation at centering}\end{array}\right) - \left(\begin{array}{c}\text{desired \% of}\\ \text{modulation at}\\ \text{centering}\end{array}\right)^{*}}{\left(\begin{array}{c}\text{Desired \% of modulation}\\ \text{at centering}\end{array}\right)^{*}}$$

TOTAL ERROR = COMPOSITE AUDIO ERROR + PERCENTAGE OF MODULATION ERROR

* desired % of modulation at centering for LOCALIZER 20%
* desired % of modulation at centering for GLIDE SLOPE 40%

DDM setting	Composite Audio Error (DDM)	max % of Mod Error (DDM)	TOTAL (maximum error) (DDM)
LOCALIZER:			
.046	.00169	.00230	.00399
.093	.00240	.00465	.00705
.155	.00333	.00775	.01108
.200	.00400	.01000	.01400
GLIDE SLOPE:			
.045	.00168	.00225	.00393
.091	.00237	.00455	.00692
.175	.00363	.00875	.01238
.400	.00700	.02000	.02700

NAV-750A

DDM ACCURACY AT POSITIONS OTHER THAN CENTERING

COMPOSITE AUDIO ERROR = Centering Error + .02% DDM Setting

$$\text{PERCENTAGE OF MODULATION ERROR} = \text{DDM Setting} \times \frac{\left(\begin{array}{c}\text{measured, single-}\\ \text{tone, \% of modu-}\\ \text{lation at centering}\end{array}\right) - \left(\begin{array}{c}\text{desired \% of}\\ \text{modulation at}\\ \text{centering}\end{array}\right)^{*}}{\left(\begin{array}{c}\text{Desired \% of modulation}\\ \text{at centering}\end{array}\right)^{*}}$$

TOTAL ERROR = COMPOSITE AUDIO ERROR + PERCENTAGE OF MODULATION ERROR

*desired % of modulation at centering for LOCALIZER 20%
*desired % of modulation at centering for GLIDE SLOPE 40%

DDM setting	Composite Audio Error (DDM)	max % of Mod Error (DDM)	TOTAL (maximum error) (DDM)
LOCALIZER:			
.046	.00101	.00230	.00331
.093	.00102	.00465	.00567
.155	.00103	.00775	.00878
.200	.00104	.01000	.01104
GLIDE SLOPE:			
.045	.00101	.00225	.00326
.091	.00102	.00455	.00557
.175	.00104	.00875	.00979
.400	.00108	.02000	.02108

Technical Summary

VOR Section:

Bearing Selection:	Twelve preset headings each 30°. Additional +10° and -10° steps from any bearing selected. Bearing knob gives continuous bearing adjustment in .01° or .05° steps.
Bearing Accuracy:	± .05° on all headings
Bearing Monitor:	By independent counter; displays bearing to .01° resolution.
VOR Tones:	30Hz REF and 30Hz VAR tones derived from 2.16 MHz crystal oscillator. 9960Hz is frequency locked to the 2.16 MHz crystal.
Ident Tone:	1020Hz tone may be added at 0 to 60% mod.

LOC Section:

Deviation:	± .046 DDM, ± .093 DDM, ± .155 DDM, and continuously adjustable ± .4 DDM. One tone may be deleted while the other is at 20%.
Centering Accuracy:	± .001 DDM (± .85uA)
Tones:	90Hz and 150Hz tones phase-locked to ± .1° or phase variable at five times the angle selected by the VOR bearing selector. 1020Hz tone may be added.

GS Section:

Deviation:	± .045 DDM, ± .091 DDM ± .175 DDM, and continuously adjustable ± .8 DDM. One tone may be deleted while the other is at 40%.

Centering Accuracy:	± .001 DDM (± 1uA)
Tones:	Same as LOC

COMM Section:

Modulation:	1020Hz tone 0-60% for audio tests. External modulation may also be added.

RF Generator:

Frequency Range:	108 to 156 MHz in 25 kHz increments. 329 to 335 MHz.
Frequency Selection:	Manually by thumbwheel switch. Automatically at a variable rate in 25, 50, 100, or 200 kHz increments, up in frequency only. Auto channeling stops at 117.95 and 135.975 MHz. Channeling may also be done by external input at rear panel.
Variable Frequency:	±50 kHz from 108 to 156 MHz ±150 kHz from 329 to 335 MHz. Generator remains phase locked at all fixed and variable frequencies.
Frequency Accuracy:	Controlled by oven crystal to ± .00020%.
Frequency Monitor:	By independent counter to 1 kHz or 0.1 kHz resolution. Counter time base ± .0001%.
Remote Function:	Frequency in use fed to rear panel as 2 out of 5 channeling. Remote channeling follows manual or auto selection.
Modulation Selection:	Automatic by frequency selected. VOR mod applied if on any VOR freq, LOC mod applied if on any LOC freq, GS mod applied if on any LOC freq and LOC/GS switch in GS position.

External Modulation:	May be added to any signal through rear panel jack. (J18)
Impedance (J18):	1K ohm nominal
Sensitivity:	9.1V P-P (±0.6V) = 30% (MASTER MOD in Cal position)
Demod Output:	For any signal at a rear panel jack. (J23)
Impedance (J23):	1K ohm nominal
DC Voltage:	3.75V (±0.3V)
AC Voltage:	2.72V (±0.2V) = 100% Modulation (±0.2V due to differences in sets)
Rear Panel Connectors:	External Modulation Input VOR Composite Tones output VOR 30Hz VAR Tone output VOR 9960Hz FM Tone output 1020Hz Tone output VOR 30Hz REF Tone output 150Hz Tone output 90Hz Tone output RF Demod output AC Power Input (See power requirements below) External Clock Input Remote Channeling Input Remote Channeling output
Power Requirements:	105 to 120 VAC or 220 to 250 VAC, 50 to 400Hz
Size:	7.5" high by 16.75" wide by 18.375" deep
Weight:	Approximately 40 pounds (45 pounds with option A)

SECTION II

Inspection

2-1. Inspection.

2-2. This instrument was carefully inspected both mechanically and electrically before shipment. It should be physically free of mars or scratches and in perfect electrical order upon receipt. To confirm this, the instrument should be inspected for physical damage in transit. Also, check for supplied accessories, and test the electrical performance of the instrument using the procedure outlined in Section V of this manual. If there is any damage or deficiency, file a claim with the carrier, and refer to the Warranty portion in Section I of this manual. If it should become necessary to ship the instrument, refer to paragraph 1 - K for shipping instructions.

2-3. Grounding Requirements.

2-4. To protect operating personnel, the National Electrical Manufacturer's Association (NEMA) recommends that the instrument panel and cabinet be grounded. All IFR instruments are equipped with a three-conductor power cord which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the power cord three -prong connector is the ground wire.

2-5. To preserve the protection feature when operating the instrument from a two-contact outlet, use a three-prong to two-prong adapter and connect the green pigtail on the adapter to ground.

2-6. Rack/Bench Installation.

This instrument is initially shipped as a bench-type instrument (unless ordered specifically as a rack type) with plastic feet in place. Conversion to a rack-mounted instrument can be accomplished by using the Rack Mounting Kit available from the factory upon request.

2-7. Repackaging for Shipment.

2-8. The following is a general guide for repackaging for shipment. If you have any questions, contact the IFR Shipping Department. (See Section I, Paragraph K)

———— NOTE ————

If the instrument is to be shipped to IFR for service or repair, attach a tag to the instrument identifying the owner and indicating the service or repair to be accomplished; include the model number and full serial number of the instrument. In any correspondence identify the instrument by prefix, model and serial number.

Place instrument in original container if available. If original container is not available, contact IFR for shipping instructions.

Do not return the instrument or its component parts to IFR, Inc. for repair without first receiving authorization from IFR, Inc. Refer to paragraph 1-H for complete instructions.

SECTION II

Inspection/Check

2-1.1 Introduction.

2-2.1 This section presents instructions to determine, by inspection, the general condition of the NAV-750 and possible faults found through either normal operation or performance tests.

2-3.1 It has been found through hard experience that deliberate moving, however slight, of the discrete components on the various PC boards or other assemblies will often cause circuit problems which were not originally causes of problems. This can quickly change simple problems into complex ones. Therefore the factory recommends only a close visual inspection without touching the components.

2-4.1 Cleaning.

2-5.1 It is wise to clean the dust, cobwebs, etc., out of the test set prior to inspection, repair, or calibration. Some shops clean their test equipment on a regular basis such as bi annual or annual proof-of-performance checks.

2-6.1 It is recommended that dust removal be done with a hand controlled dry air jet of not too high pressure (25-50 psi). The fan blades, rotor and frame should be wiped with a lint-free cloth moistened with rubbing alcohol. The rear panel should be cleaned with a dry cloth only. The front panel may be cleaned whenever necessary with a lint-free cloth moistened with rubbing alcohol.

2-7.1 Care must be taken to avoid breaking wires or shorting component leads together during cleaning.

2-8.1 Inspection/Check.

2-9.1 Procedures:

A. Bearing Pickoff Sensors. The bearing pickoff sensors may be located by looking at the Top View Fig 8-1 Accumulated dirt can cause sluggish operation or failure of the bearing pickoff sensors. It may be cleaned with a soft brush moistened with rubbing alcohol.

B. Chassis. Includes anything mechanical or made from metal. Inspect for tightness of sub-assemblies, damaged connectors, corrosion or damage to the metal surfaces, etc. Surface corrosion may indicate damage inside the affected part.

C. Inspect for loose mounting, body damage, case damage, leakage or corrosion around leads.

D. Jacks. Inspect all coax jacks for loose or broken parts, cracked insulation, bad contacts, etc. Do not disassemble connectors within the test set.

E. Potentiometers. Any potentiometer that feels rough when rotated or produces circuit or voltage irregularities should be checked with an ohmmeter for proper operation.

F. Resistors. Inspect all types of resistors for cracked, broken or charred or blistered bodies and loose or corroded soldering connections.

G. Printed Circuit Boards. Check connectors for corrosion and damage and the mating plugs for similiar damage. Inspect all mounted componets for damage including crystals and IC's. The boards should be free of all foreign material.

H. Semiconductors. Inspect all diodes, rectifiers and transistors for cracked, broken, charred or discolored bodies. Check ends of components for seals around leads.

I. Switches. Examine all toggle switches for loose levers and terminals, loose body to frame condition. The line switch contacts should not be bent nor the switch action too loose. The thumbwheel switches should have definate detents and not feel loose.

J. Transformer. Inspect the transformer for signs of excessive heating, broken or charred insulation, loose mounting hardware and other abnormal conditions.

K. Wiring. Inspect all wiring of chassis for broken or loose ends and connections and proper dress relative to other chassis parts. All laced wiring should be tight with ends securely tied.

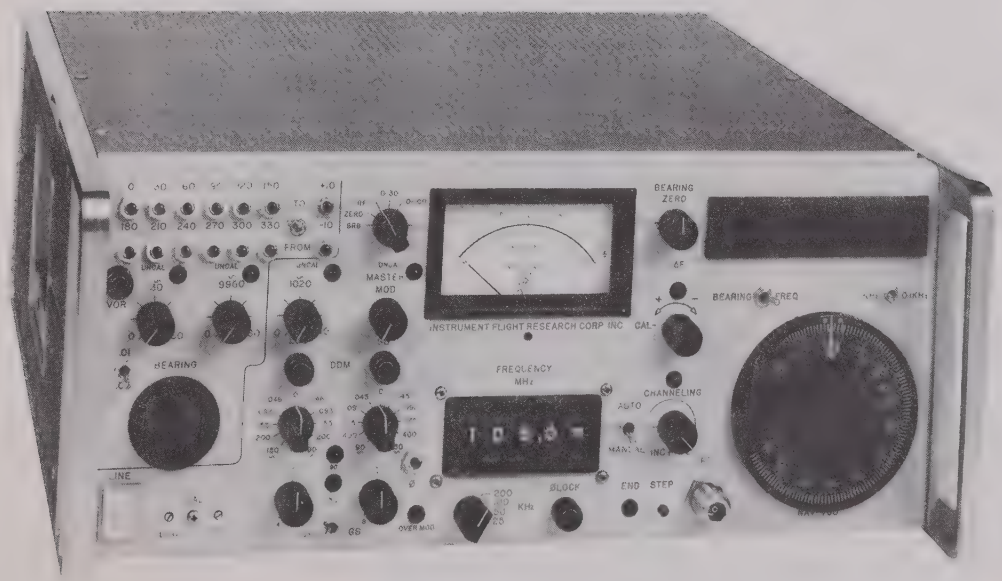
SECTION III

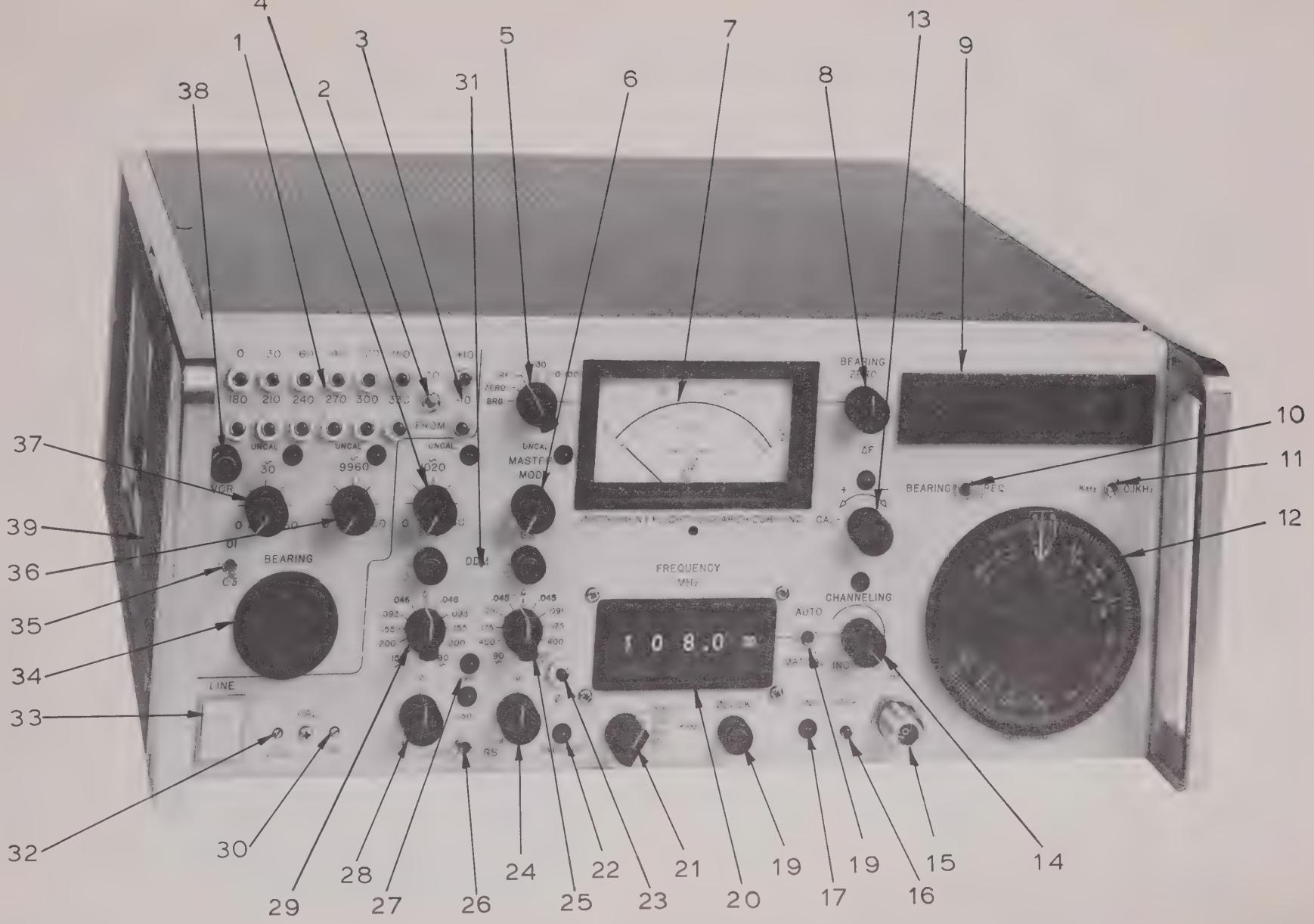
Operation

3-1. Introduction.

3-2. This section contains instructions and information necessary for operation of the IFR Model NAV-750 VOR/LOC/COMM/ and GS Bench Test Set.

3-3. Included in this section are identification of front and rear panel controls, indicators and connectors; operation with equipment being tested and information useful in applications for NAV-COMM testing.





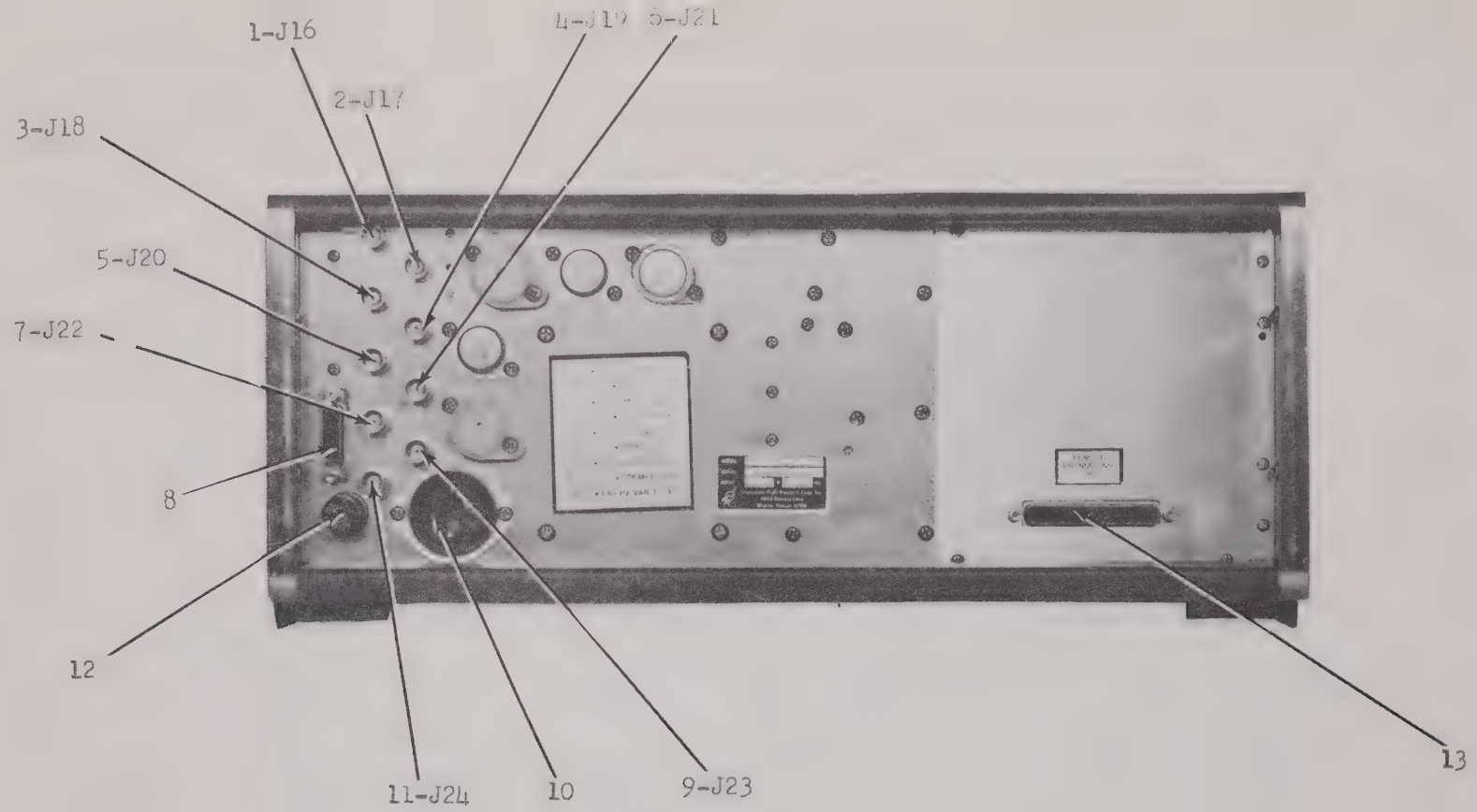
FRONT PANEL CONTROLS, CONNECTORS, AND INDICATORS

NAV-750

FIG. 3-1

FRONT PANEL		Paragraph
1.	VOR Bearing Select Pushbutton Switches	3-6
2.	TO/FROM Bearing Switch	3-7
3.	± 10 degree Bearing Pushbutton Swithes	3-8
4.	1020Hz Ident Tone Modulation Level Control	3-9
5.	Meter Function Switch	3-10
6.	Master Modulation Level Control	3-11
7.	Meter	3-12
8.	Bearing Zero Adjust Control	3-13
9.	Bearing/Frequency Dispaly	3-14
10.	Display Function Switch	3-15
11.	Frequency Resolution Switch	3-16
12.	Attenuator	3-17
13.	Variable RF Frequency Control	3-18
14.	Channeling Rate Control	3-19
15.	RF Output Connector	3-20
16.	Manual Frequency Stepping Switch	3-21
17.	End Channeling Lamp	3-22
18.	Auto/Manual Frequency Control	3-23
19.	Phase Lock Indicator	3-24
20.	Frequency Select Switches	3-25
21.	Channeling Frequency Increment Switch	3-26
22.	Over-modulation Indicator	3-27
23.	90Hz/150Hz Phase Deviation Switch	3-28
24.	GS Variable Deviation Control	3-29
25.	GS Step Deviation Control	3-30
26.	LOC/GS Frequency Select Switch	3-31
27.	90Hz and 150Hz Tone Off Indicators	3-32
28.	LOC Variable Deviation Control	3-33
29.	LOC Step Deviation Control	3-34
30.	GS Calibration Adjust	3-35
31.	LOC/GS Mode Indicators	3-36
32.	LOC Calibration Adjust	3-37
33.	AC Power Line Switch	3-38
34.	Variable Bearing Control	3-39
35.	.01 or .05 Degree Variable Brg Select	3-40
36.	9960Hz FM Tone Modulation Level Control	3-41
37.	30Hz Tone Modulation Level Control	3-42
38.	VOR Mode Indicator	3-43
39.	Audio Level Control	3-44

REAR PANEL		Paragraph
1.	1020Hz Tone Out	3-46
2.	90Hz Tone Out	3-47
3.	External Modulation Input	3-48
4.	150Hz Tone Out	3-49
5.	9960Hz Tone Out	3-50
6.	Sum of Tones Out	3-51
7.	30Hz Ref Tone Out	3-52
8.	Accessory Plug	3-53
9.	RF Demod Out	3-54
10.	AC input Connector	3-55
11.	30Hz Var Tone Out	3-56
12.	AC Line Fuse	3-57
13.	Remote Channeling Output	3-58



REAR PANEL CONNECTORS

NAV-750

FIG 3-2

Front Panel Controls and Indicators

3-1. General.

3-2. The NAV-750 is a completely self-contained simulator for VOR, LOC, GS and COMM testing of avionics equipment. All necessary signals, audio and RF, are generated and controlled within the one set. In addition, provision is made to remotely channel a receiver for rapid tests of frequency and sensitivity tests, etc.

3-3. Controls, Connectors and Indicators.

3-4. The location of all controls, connectors, and indicators is shown in Figure 3-1 and Figure 3-2. The following paragraphs explain their functions in detail.

3-5. Front Panel.

3-6. VOR Bearing Select Pushbutton Switches. Depressing any of these twelve switches incremented on the 30° cardinal headings instantly sets the VOR Bearing to the heading. The switches may be pressed in ony order or sequence.

3-7. TO/FROM Bearing Switch. Sets the VOR output to a TO or FROM condition. The receiver VOR indicator should agree with the switch position.

3-8. ±10 Degree Bearing Switches. When depressed these switches add or subtract a precise ten degrees from whatever VOR heading the NAV-750 is putting out.

3-9. 1020Hz Ident Tone Mode Level Control. When rotated fully CCW into a detent click position the 1020Hz tone is off in LOC and VOR modes and on with 30% mod level in COMM modes. On COMM the tone may be deleted by setting the control to zero, and it can be varied 0 to 60% mod level from there. On VOR the tone is added as CW rotation is made for mod levels of 0-60%.

3-10. Meter Function Switch. Selects use of meter. The BRG and ZERO positions check the accuracy of the VOR output. RF checks the RF level into the attenuator. The 0-30 and 0-100 positions are for setting or checking the modulation levels of the various signals.

3-11. Master Modulation Level Control. In the full CCW position the mod levels are preset to calibrated levels. When rotated CW these levels can be varied from zero to approx twice normal level or 100%, whichever is greater. An UNCAL lamp indicates when variable levels are in use.

3-12. Meter. Indicates: 1) Bearing deviation in .01 degree increments from zero. 50 on the lower scale represents zero deviation. Each number to the left of 50 is - .01 degrees; to the right of 50 + .01 degrees. Thus 20 is - .03 degrees and 90 is + .04 degrees. 2) Zero sets the bearing check circuit to zero in conjunction with the Bearing Zero Control. 3) RF checks the RF level entering the attenuator to be accurate. 4) 0-30 uses the top scale for 0-30% mod. 5) 0-100 uses the lower scale for 0-100% mod.

3-13. Bearing Zero Adjust Control. Sets the bearing check circuit to zero as indicated by center scale of the meter.

3-14. Bearing/Frequency Display. Reads out the VOR bearing to .01 degrees, or the generator output RF frequency (see 3-16 below).

3-15. Display Function Switch. Selects the readout of the display (see 3-14) to present either frequency or VOR bearing information.

3-16. Frequency Resolution Switch. Selects the display to read to the nearest 1 kHz or 100Hz of RF frequency.

3-17. Attenuator. Sets the RF output level to between -6 dBm to -120 dBm.

3-18. Variable RF Frequency Control. When rotated fully CCW into a detent position the output frequency is that set on the thumbwheel switches or displayed on the readouts. When rotated CW it varies the output frequency ±50 kHz (approx) on the VOR, LOC and COMM frequencies, and ±150 kHz (approx) on the GS frequencies.

3-19. Channeling Rate Control. Sets the rate the channeling (automatic) of the output frequency takes place. Maximum rate is full CW rotation. Full CCW rotation stops automatic channeling.

3-20. RF Output Connector. Presents RF at 50 ohms impedance to be applied to a receiver being tested.

3-21. Manual Frequency Stepping Switch. Used to manually channel the frequency if automatic stepping is not desired. AUTO/MANUAL Select switch must be in AUTO position.

3-22. End Channeling Lamp. Indicates when channeling has reached 117.95 MHz, 135.975 MHz, or 157.95 MHz. Auto channeling will stop when these frequencies are attained.

3-23. Auto/Manual Frequency Control. Selects whether channeling will be controlled automatically or manually.

3-24. Phase Lock Indicator. When on, it shows the RF generator is controlled by the phase lock system. If Off, the generator is out of frequency control.

3-25. Frequency Select Switches. Sets the output frequency of the generator, if the CHANNELING is Off. When channeling is used it sets the starting frequency for channeling, which will increase frequency from start.

3-26. Channeling Frequency Increment Switch. Selects the frequency spacing when channeling is used. The frequency will increase in 25, 50, 100, and 200 kHz steps.

3-27. Over-Modulation Indicator. Indicates when 100% modulation is attained on any frequency.

3-28. 90Hz - 150Hz Phase Deviation Switch. The phase of the 90Hz and 150Hz LOC and GS tones is ordinarily fixed to within ± .1 degree. For testing purposes this phase can be varied by depressing the Phase Deviation Switch. Then the 150Hz tone is retarded by an angle five times greater than the angle of the VOR bearing selector.

3-29. GS Variable Deviation Control. Varies the GS deviation by ± .8 DDM for full rotation.

3-30. GS Step Deviation Control. Selects precise GS deviations in ± .045, .091, .175 and .400 increments. When in either the 90Hz or 150Hz positions that tone only is present in the GS output, the other tone being turned off. In the downward position the variable control (see 3-29) does all GS deviations.

3-31. LOC/GS Frequency Select Switch. In LOC position whenever the Frequency Select Switch is set to a LOC frequency the LOC Mode will be selected and LOC Modulation selected. In GS position the GS Mode and Modulation will be selected if a LOC/GS paired frequency is channeled. VOR channels are selected between the LOC and GS channels.

3-32. 90Hz and 150Hz Tone Off Indicators. When either the LOC or GS Step Deviation Controls are set to 150 or 90Hz the

opposite tone is deleted. The tone deleted is shown by one of the two lamps. Both tones can be deleted at the same time which stops all LOC or GS output (except for Ident tones).

3-33. LOC Variable Deviation Control. Varies the LOC deviation by ± .4 DDM for full rotation.

3-34. LOC Step Deviation Control. Selects precise LOC deviation of ± .046, .093, .155, and .200 DDM. Also deletes a tone or selects a single tone output. Single tones are at a 0 DDM level.

3-35. GS Calibration Adjust. Used to precisely match the 90Hz and 150Hz tone levels. This control varies the 90Hz level to be matched to the 150Hz tone.

3-36. LOC/GS Mode Indicators. Indicates whether the NAV-750 is in LOC or GS.

3-37. LOC Calibration Adjust. Used to calibrate the LOC course centering. Operates same as GS calibration in 3-35.

3-38. AC Power Line Switch. Applies power to test set. Switch is illuminated when power is on.

3-39. Variable Bearing Control. When rotated clockwise the control increases the VOR bearing in .01 or .05 degree steps. If rotated counter-clockwise the bearing is decreased. If 359.99 degrees or 0.01 degrees is reached the bearing starts over continuing around the circle indefinitely. The bearing can be set to any 30° incremental heading by the pushbuttons and then varied with this control, etc.

3-40. .01 or .05 degree Select Switch. Selects whether the Variable Bearing Control increments the VOR heading in .01 or .05 degree steps.

3-41. 9960Hz FM Tone Modulation Level Control. When set fully CCW in the detent position the 9960Hz in VOR Mode is set to 30% modulation. By rotating CW the modulation can be varied 0 to 60%. An indicator lamp shows uncalibrated operation.

3-42. 30Hz Tone Modulation Level Control. This control operates identical to the 9960Hz level control explained in 3-41 except it affects the 30Hz tone.

3-43. VOR Mode Indicator. Shows when the test set is in VOR operation with VOR modulation at the output.

3-44. Audio Level Control. Adjusts the audio level applied to the speaker when channeling is taking place. A short tone burst aurally indicates the test set has advanced to a different frequency.

Rear Panel

3-45. 1020Hz Tone Out. This connector presents the 1020Hz tone for external use.

3-46. 90Hz Tone Out. Same as 3-45 except applies to the 90Hz tone.

3-47. External Modulation Input. External audio tones may be applied to this input to add modulation to any signal except GS.

3-48. 150Hz Tone Out. Same as 3-45 except applies to the 150Hz tone.

3-49. 9960Hz Tone Out. Same as 3-45 except applies to the 150Hz tone.

3-50. Sum of Tones Out. The modulation (total) present on the mode in use - VOR, LOC, GS, COMM - is presented at this connector. Most used for the VOR modulation signal in testing VOR receiver accuracy.

3-51. 30Hz Ref Tone Out. Same as 3-45 except applies to the 30Hz tone. Does not contain the 9960Hz tone.

3-52. Accessory Connector. Various inputs and outputs are presented here, such as remote channeling input, power supply voltages, etc. See Fig (4-3)

3-53. RF Demod Out. The modulation present on the output RF signal is demodulated and applied at this connector.

3-54. AC Input Connector. AC power either 115 VAC or 240 VAC (must be switched internally) is applied here.

3-55. 30Hz Var Tone Out. Same as 3-45 except applies to the 30Hz Var Tone.

3-56. AC Line Fuse. Fuse for AC power input. 1.0A @ 115 VAC, 0.5A @ 230 VAC.

3-57. Remote Channeling Output. Contains channeling information to remotely control a receiver to cause it to "track" the output frequency of the NAV-750. The ARINC 2 out of 5 code is used.

3-58. Internal Controls.

3-59. There are no internal controls useful during normal test set use. Internal adjustments are provided for calibration, which requires use of other pieces of test equipment, etc, and cannot be set in a haphazard manner.

NAV-750 Operation Procedures

3-1.1 Introduction.

3-2.1 Perh a ps like no other test set has been before, the NAV-750 was designed for greatest ease of operation. Most functions are automatic and signal parameters controlled by the test set itself. Bearing selection is fast and fully digital with instant display to .01 degree. LOC and GS deviations are one-switch operation. Even the operating mode is selected by the frequency in use between the four possible modes. No external pieces of equipment are required. Circuits are built-in to allow calibration of LOC and GS centering, and verify VOR bearing accuracy.

3-3.1 Before initial use of the NAV-750 it is urged that the operator read Section III and get a grasp of the various control functions. They are presented in simple form without other material added. This section will polish your knowledge of the controls and explain connections to other equipments.

3-4.1 VOR Testing.

3-5.1 Equipment Set-Up. Connections to a VOR receiver (as well as LOC, GS and COMM receivers) are shown in Figure 4-1. If remote channeling is not used, only the antenna lead need be connected. For remote channeling refer to figure 4-2, Remote Channeling Connector Pin Assignments. Figure 4-2 gives the ARINC used 2 out of 5 code for reference.

3-6.1 Select a VOR frequency on the Frequency Select Switches. The VOR Mode lamp should come on. Set the CHANNELING RATE control fully CCW to prevent accidental channeling to LOC frequency.

3-7.1 Set the 30Hz, 9960Hz, 1020Hz and MASTER MOD Controls to the full CCW detent click position. All UNCAL lamps for these controls should be off.

3-8.1 The VOR Bearing desired may be set by depressing one of the 30° heading switches, and modifying that heading with the ± 10° switches and the Bearing Select Control. Rotating the control CW increases the heading in .01 or .05 degree steps selected by a nearby switch. CCW rotation reduces the heading. The bearing being put out by the test set is displayed on the readouts to .01 degree.

3-9.1 No matter what the test set heading is, the heading can be instantly changed by depressing the switches or rotating the Bearing Wheel. The bearing change is also instant at the test set output with no settling time required.

3-10.1 Levels of the 30Hz Variable tone and 9960Hz FM tone can be varied from 0 to 60% modulation each with their respective controls. When taken out of the detent positions the respective UNCAL lamp will light. If more than 100% modulation is called for the OVER MOD lamp will come on.

3-11.1 Ident Tone - 1020Hz - will be off with the control in detent position on VOR. Rotating the control CW turns on the tone and it may be added from 0 to 60% modulation level also.

3-12.1 The Master Modulation Control will vary all modulation applied at particular time from zero to approximately twice normal levels - providing 100% mod is not exceeded.

3-13-.1 The Output Attenuator sets the RF level at the output connector and can vary the level from -6 to -120 dBm, or 112,000uV to .224uV. Refer to Figure 4-5 for a handy dB to volts and watts chart for levels to -100 dBm.

3-14.1 The VOR channels may be automatically selected by placing the AUTO/MANUAL switch to AUTO and rotating the channeling control CW until the desired rate is attained. If the starting frequency is 108.0, select 200 kHz on the channeling increment switch and every 200 kHz frequency will be selected up to 117.95 where the auto channeling will stop. Other frequencies and increments can be likewise selected.

3-15.1 For each frequency, the Phase LOCK lamp should be on. If not, probably the Variable Frequency control is not in the detent position.

3-16.1 If desired or required, another bearing clock frequency can be inserted at the Accessory Connector. Pin 8 must be grounded for external clock operation. The clock input must be TTL compatible (0-5V square wave).

3-17.1 The VOR Bearing can be verified to be within the specified ± .05 degrees by the following steps.

1. Select heading of 90°.
2. Select ZERO on the Meter Switch.
3. Allow the meter to center itself, or settle to no or little movement.
4. If the meter is not centered, operate the BEARING ZERO control to center the needle.

5. Switch the meter to BRG
6. Read the bearing error by using the lower meter scale. Each major division is .01 degrees; center is zero error. e.g. 10 would be - .04 degrees and 60 would be +.01 degrees.

3-18.1 LOC and GS Operation.

3-19.1 LOC and GS operation are very similar and differ only in frequencies used and modulation levels used. Therefore they will be explained together.

3-20.1 Select a LOC frequency on the Frequency Select Switches. Set the Channeling Rate Control full CCW. Set the LOC/GS switch to LOC.

3-21.1 If a proper LOC frequency was chosen the LOC Mode lamp will light. Set the 1020Hz and Master Mod controls to full CCW. Now each LOC tone (150Hz and 90Hz) will be modulating 20%. There will be no Ident 1020Hz tone present.

3-22.1 The LOC deviation is selected by the step-position DDM control. CCW rotation from zero gives left needle deflection on the receiver indicator, and CW rotation right deflection. The various DDM deviations are further explained in Figure 4-6, LOC and GS DDM correspondence chart.

3-23.1 If the DDM control is set to either the 150Hz or 90Hz position, that tone will be the only one present at 20% modulation while the other tone will be deleted. Should by some chance the GS control be set to one tone and the LOC control to the other tone, both tones will be deleted and neither would appear in the output.

3-24.1 Whenever a tone is deleted the corresponding warning lamp will light to guard against inadvertent wrong output test signals.

3-25.1 In the downward position the Variable DDM control is activated and controls the LOC deviation from zero to ± 0.4 DDM or twice the deflection the switch control gives. It is continuously variable from minus to plus .4 DDM.

3-26.1 LOC centering may be calibrated by setting the stepped position switch to 0 DDM. Set the meter switch to the 0-30% mod range. Using the GS stepped switch, delete the 90Hz tone by setting it to 150Hz. Read closely the modulation level of the 150Hz tone.

3-27.1 Next delete the 150Hz tone by setting the GS control to 90Hz.

3-28.1 Read the level of the 90Hz tone. If it does not agree exactly with the level of the 150Hz tone, adjust the front panel LOC CAL control to achieve equal percentages of modulation for both tones.

3-29.1 The 1020Hz Ident tone may be added to the LOC output signal only by rotating the control clockwise from the detent position. The tone may be added 0-60% mod.

3-30.1 The relative phase of the 90 and 150Hz tones is fixed but may be temporarily changed by depressing the Ø switch located near the GS deviation switch. When depressed, the variation in phase of the 150Hz tone relative to the 90Hz tone is retarded at five times the angle selected by the VOR bearing selector, which can still be read out by the display. An indicated bearing of 2° would make the 150Hz tone lag the 90Hz tone by 10°, etc.

3-31.1 All the above information contained in paragraphs 3-21 through 3-30.1 applies equally to the GS tone controls. The LOC deviation switch is used to delete tones to set GS centering, etc.

3-32.1 The frequency in use determines the modulation selected - - LOC or GS. If the LOC-GS switch is in LOC all LOC frequencies selected will select LOC modulation. But in GS position the generator will change to RF output in the 330 MHz GS band and also select GS modulation. Auto or manual channeling can be used to select all available LOC and GS frequencies. GS frequencies may also be selected by directly selecting the GS frequency on the Frequency Select Switches. The display will indicate the actual output frequency in use.

3-33.1 A note about the generator output frequency which applies to VOR, LOC, GS, and COMM outputs. With the Variable Frequency Control full CCW the frequency is controlled by a phase-lock system referenced to a temperature-stabilized oscillator. Either the channeling system or frequency switch control the output.

3-34.1 When the Variable Frequency Control is rotated CW, the output can be deviated by approximately ± 50 kHz on all bands except GS where ± 150 kHz is available. Stability in the variable mode is excellent.

3-35.1 COMM Testing.

3-36.1 The generator covers all COMM frequencies from 118.00 through 135.975 MHz in one band, and from 136.00 to 156.00 MHz in another band. Frequencies may be selected in 25 kHz steps if required.

3-37.1 When using the automatic channeling mode the channeling will stop at 135.975 MHz. Then 136.00 MHz must be selected on the selector switches and the channeling will continue to 157.95 MHz and stop again.

3-38.1 The Ident Tone on COMM is on at a 30% mod level when the 1020Hz level control is in the detent position. The tone may be turned off by moving the control to the "0" position. From there the tone may again be added at a level from 0 to 60% mod.

3-39.1 For remote channeling of a receiver of any type using the 2 out of 5 select system, the .01 MHz, .1 MHz, 1 MHz and 10 MHz frequency channeling outputs are available at the Channeling Output connector on the rear panel. A wiring harness will have to be constructed for each receiver used.

3-40.1 The remote channeling follows whatever frequency is being displayed at any instant by the counter display.

3-41.1 The test set may be channeled from a remote source by an input from a section of automatic test equipment. For example, if receiver sensitivity over the range of a receiver's operating frequencies is to be checked, the following set-up can be used.

3-42.1 The receiver can be channeled from the NAV-750. Channeling should begin from the low end of the band of frequencies to be checked. The NAV-750 can be remotely advanced in channeling from a piece of ATC equipment which is checking for receiver output on each new frequency. The NAV-750 attenuator will be set to a minimum level desired to pass a sensitivity test. If a certain frequency of the receiver does not meet requirements, channeling may be stopped or the ATC will note on a printout the faulty frequency.

3-43.1 Other semi-automatic or automatic arrangements can be made depending on the users equipment to be used in testing with the NAV-750 as the "core" equipment.

3-44.1 On the rear panel, each of the modulating tones is present for use in other specialized receiver section tests. Often the sum of all tones output is used to check VOR bearing circuits directly without using the RF portion of the receiver.

SECTION IV

Theory of Operation

4-1. Introduction.

4-2. This section contains the circuit-theory of operation for IFR Model NAV-750 NAV-COMM Bench Test Set. Included is a general description, a block diagram desription, and individual description of circuits within the NAV-750 Test Set.

4-3. General Description of Test Set Operation.

4-4. The NAV-750 can be divided into several sections or groups which when studied individually can be more easily understood. Essentially each section can function independently of the others except the power supply, which is common to all other sections. The various sections are: 1) the VOR section, 2) the LOC and GS section, 3) the RF generator section, and 4) the Power Supply Section.

4-5. The VOR section is mainly located on PC-4 and PC-5. The bearing is selected on these boards, and the bearing oscillator is there. The two 30Hz signals, reference and variable, are applied to PC-2 where the square wave inputs are converted to sine waveforms, combined onto a 9960Hz signal and fed to PC-3.

4-6. On PC-3 the VOR tones are applied to controls to vary their modulation level. PC-3 also switches all modulation tones requred as determined by the RF frequency selected. The tones are then summed together and sent to the Mod/Amp assembly.

4-7. The VOR Bearing selected is displayed on a counter readout on the front panel. An RF DEMOD output is used to check the accuracy of the bearing at 90° and 270° by circuitry on PC-1.

4-8. The 90Hz and 150Hz tones are picked off the VOR bearing counter on PC-4 as square waves and are thus crystal-controlled in frequency and also controlled in phase relationship. The phase of the two signals is normally fixed but may be varied by shifting the 150Hz phase at a rate five times the selected VOR bearing.

4-9. The 90Hz and 150Hz square wave tones are applied from PC-4 to PC-5 where they are converted to sine waves. They are then combined at the front panel deviation switches, sent through the Tone Summation board, PC-3, and applied to the Mod/Amp assembly.

4-10. For COMM operation a 1020Hz tone oscillator on PC-2 is used as a test tone to modulate RF signals from 118.0 to 155 MHz. The 1020Hz tone is also used as an Ident signal on the VOR and LOC outputs.

4-11. The RF section consists of an oscillator controlled by a phase locked crystal reference system. The frequency is controlled by PC-6 where either a front panel set of frequency switches or internal counters controlled by a frequency channeling circuit select the desired output.

4-12. The selected frequency is translated into a 2 out of 5 select system on PC-7 which controls outputs at a rear panel connector to remotely channel a set being tested.

4-13. The RF from the Oscillator assembly is applied to the Mod-Amp, where modulation is imposed on the signal, then passed through an attenuator to the panel RF Output connector.

4-14. The Power section supplies six voltages of +5, +12, -12, +24, -18, and +170 volts relative to chassis as common ground. The 170 volts is used only for the HV gas discharge counter displays. The other four voltages are used generally throughout the NAV-750. The input to the power system is 115-240 VAC, 50Hz to 400Hz.

4-15. VOR Section.

4-16. Refer to the Simplified VOR Section Block Diagram, Fig 4- and to the schematics for PC-4 and PC-5, Fig 9-

4-17. The VOR bearing is referenced to a 2.16 MHz crystal oscillator on PC-4 using parts of X401 and X431. C401 sets the frequency precisely. If an external clock source is required, grounding pin J10-8 stops the osc. The ext input is applied at J10-9 and should be TTL compatible. (0-5V square wave)

4-18. X430 divides the 2.16 MHz to 1.08 MHz which is the frequency required for a .01° count. This frequency is applied to five counter stages to give bearing counts of .01, .1, 1, 10, and 100° steps. At a count representing 360° they are reset to zero, then begins to count up again.

4-19. At a count of 180°, a gate, X435B, senses the 80° output of the 10° counter, and the 100° output of the 100° counter. The gate output sets a FF, X429A, whose $\overline{Q}$ output forms the 30Hz Reference VOR signal. At 180° $\overline{Q}$ goes to a logic 0.

4-20. At 0° or 360° another gate senses 360° from appropriate counter outputs. This gate output operates O/S X436A which is used to give a wide reset pulse instead of the quick spike type pulse which would result if the gate output reset the counters directly.

4-21. O/S X436A does reset all the bearing counters to zero count, and also resets FF X429A. This causes $\overline{Q}$ to go high forming the other half of the 30Hz Reference signal. Therefore the reference signal is at a high level from 0° to 180°, and low from 180° to 0°.

4-22. As a by-product of the bearing counter, the 90Hz and 150Hz frequencies are derived from frequencies obtained from points in the counter. The output of the 1° decade counter is divided by twelve by X426 and the result is a 90Hz square wave. The counter is reset at the same time as the bearing counter by X436A.

4-23. The output of the .1° counter is divided by 72 to obtain 150Hz. Reset to the ÷ 72 counter is applied from one of two sources. The first source is the "normal" one and is the O/S X436A. This resets X433 and X434, the ÷ 72 unit, coincident with the bearing counter. The second reset source is the 30Hz VAR square output from FF X402. This shifts the phase of the 150Hz signal relative to the 90Hz signal in increments equal to five times the VOR selected bearing. Depressing the front panel "Ø" (phase) switch changes the reset source.

4-24. The VOR Bearing is selected by the remainder of the circuitry on PC-4 and PC-5. A programmable, up-down counter is run "parallel" to the above described bearing counter and contains stages for .01, .1, 1, 10, and 100 degree steps. The up-down counter is connected to the bearing counter through five comparator IC's, one for each counter stage. If the counts in the two counters are exactly equal, the comparator outputs all enable a set of gates (X430, X412A, X408D, X415B, X408E) to achieve a logic 0 at the output of X415B. At all other times X415B's output is high.

4-25. Assume the up-down counter has a bearing of 275° stored in it. Operation of the up-down counter will be explained later. As the bearing counter counts up from zero degrees the comparators continously compare the counts in the two parallel counters. At 275° equality is sensed and X415B's output changes to a low state. This causes FF's X430 and X402 to "set".

4-26. The FF setting causes Q output of X402B to go high and forms the positive-half of the 20Hz variable square output. Q going high also enables gate X431C which allows .01 degree pulses from X430A to be counted by a 180° counter consisting of X402, X403, X404, X405, and X406. At the accumulated count of 180° gate X401A is enabled and in turn resets FF X402B. The FF resetting causes Q output to go low, forming the last half of the 30Hz VAR square output signal.

4-27. The result of the variable square circuit is that at the selected bearing the output goes high, and is high for 180° when it goes low until the selected bearing appears at the comparator output again (180° later).

4-28. The 30Hz Variable signal described forms the "TO" output. The "FROM" output is taken from the $\overline{Q}$ output FF X402B, and is 180° out of phase with the "TO" signal. Which signal is used is selected by the front panel TO-FROM switch.

4-29. The programmed up-down counter is operated by two sources. One is a set of gating logic on PC-5 in turn operated by the 12 cardinal bearing switches on the front panel. Depressing any switch causes that particular bearing to be loaded into the up-down counter.

4-30. Whenever any bearing switch is depressed either gate X5002 or gate X5001 is disabled and through other gates causes the Load Line to go low. While the load input is low, data present at the preset inputs of the up-down counter sets the counter to correspond to that data. When any switch is activated the .01, .1, and 1 degree counters are preset to zero.

4-31. Gate X5003 always causes a bearing of 10° to be preset. X5004 always causes 20° to be preset. X5005A always causes 40° to be preset. X5005B always causes 80° to be preset. The above gates all operate on counter X413, the 10° counter. Combinations of inputs can cause any heading of 10 to 90° to be preset into X413.

4-32. X5007 always causes 100° to be preset, and X5006 always causes 200° to be preset. These two gates operate into X414, the 100° counter. Both applied together cause 300° to be preset.

4-33. When the NAV-750 is first turned on, a system normalizer causes the same reaction as depressing the 0° switch, and initally sets the up-down counter to zero bearing. The normalizer consists of X5008B and associated circuitry.

4-34. Two additional pushbutton switches allow bearing changes of +10 and -10 degrees to be made to any bearing present in the up-down counter.

If the -10° switch is depressed, X5011B is disabled and the output goes high. The output of this gate controls the up-down control line of the counter. If the line is hig the counter will count down; conversely, if the line is low the counter will count up. Thus the -10° switch causes the counter to be able to count down.

4-35. Depressing the +10° switch disables gate X5011C, causing it's output to go high and enable gate X5011B, causing it's output to go low. Thus the counter is set to count up.

4-36. The actual clock pulse causing the +10 or -10 degree count change comes from O/S X5012B. It is set through either diode CR5002 or CR5003. It operates the Schmitt Trigger X5010D and X5010E which applies one clock pulse to X413 and advances or retards the counter one count (equal to 10°). By the way the total up-down counter is connected, if X413 is at zero bearing and -10° is called for, the entire counter will retard by a 10° step. This may mean going from, for example, 5.72 degrees (-10°) to 355.72 degrees.

4-37. The second way to change count in the up-down counter to determine the VOR Bearing is by the Bearing knob on the front panel which alters the bearing in either .01 or .05 degree steps with each 1/40 revolution. The control consists of a 40-tooth gear whose teeth break the light path of two transducers. As the path is broken the transducer output goes high. One transducer is used as a clock source, the other as a direction of knob rotation sensor.

4-38. As the gear teeth break the ligh path, pulses are formed by X5013 and inverted by X5008C to form clock pulses. These are applied to O/S X5012A and to gate X5019B.

4-39. A front panel switch selects whether .01 or .05 degree increments are to be selected. If .01 degrees is desired, X5019 selects clock pulses before O/S X5012A. If .05 degree increments are to be selected, X5019 selects clock pulses from a UJT oscillator. O/S X5012A enables the UJT oscillator to operate in pulse groups of five as set by pot R5091.

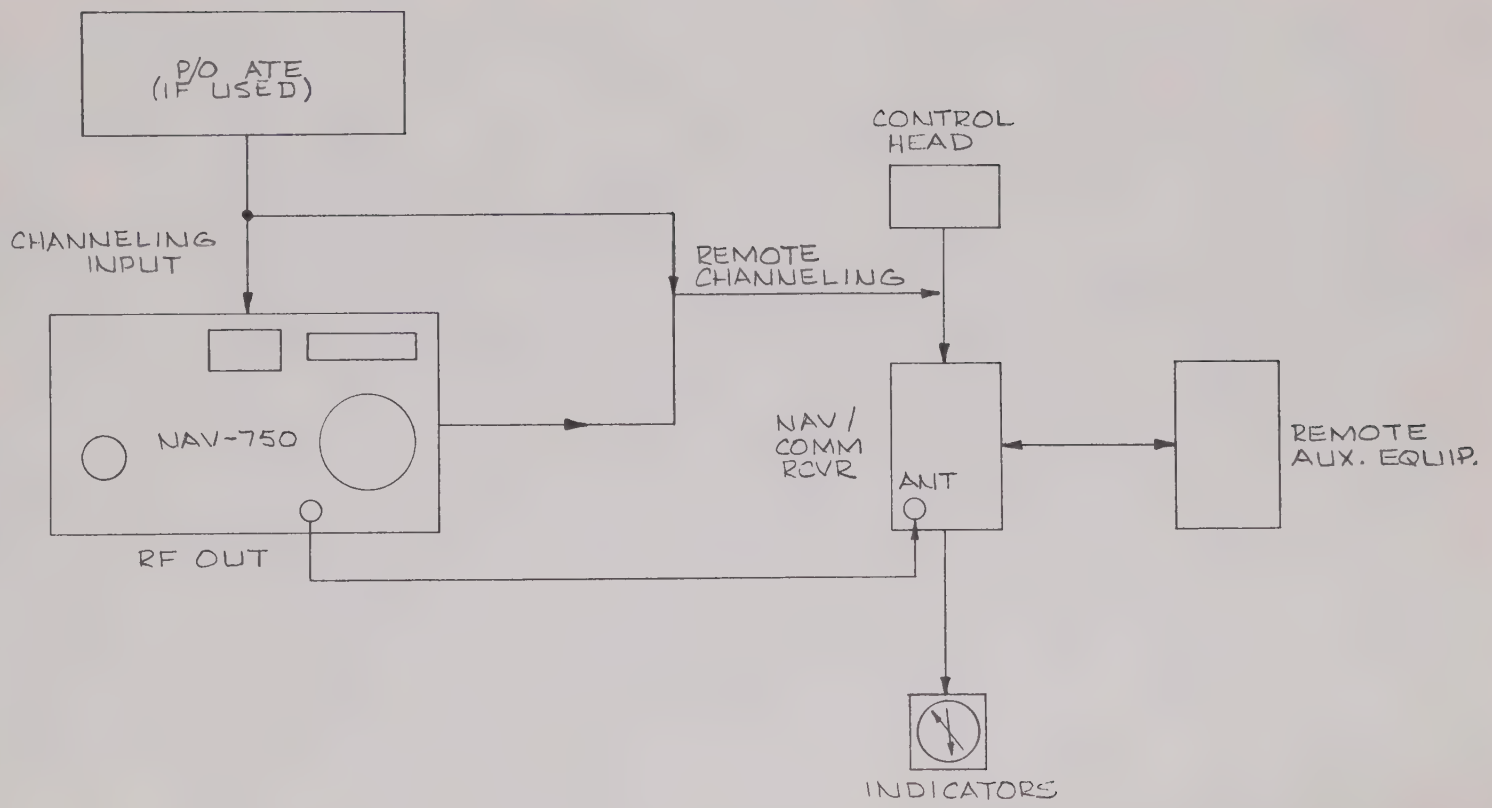
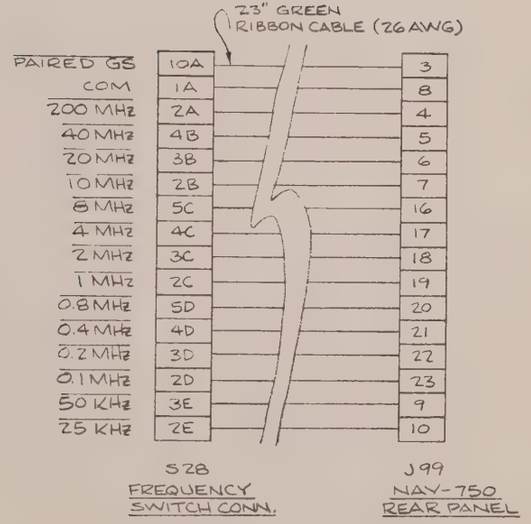
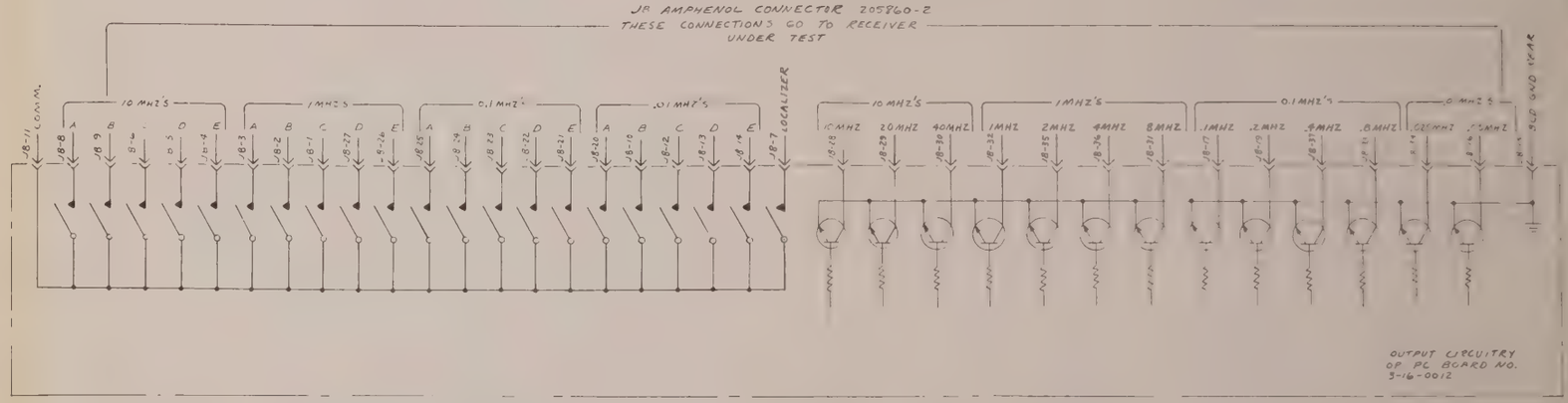


FIG 4-1
CONNECTIONS FOR VOR,
LOC, G/S OR COMM REC.



PIN CONNECTIONS FOR REMOTE FREQUENCY PROGRAMMING OPTION NAV-750A



	0	1	2	3	4	5	6	7	8	9
A		X	X						X	X
B	X	X		X	X					
C			X	X		X	X			
D					X	X		X	X	
E	X						X	X		X

FREQUENCY SELECTOR TWO-OUT-OF-FIVE BINARY CODE

FIG. 4-2

NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION
APPLICATION			LIST OF MATERIALS			

TOLERANCES UNLESS OTHERWISE SPECIFIED. ALL DIMENSIONS APPLY AFTER FINISH. DECIMALS: ± .005. ANGLES: ± 1/2°. FRACTIONS: ± 1/64. SURFACE ROUGHNESS REMOVE ALL BURRS. MATERIAL. TREATMENT. FINISH.

DRAWN JIG 5/9/73. CHECKED. APPROVED.

INSTRUMENT FLIGHT RESEARCH CORPORATION WICHITA, KANSAS

TITLE: EXT CONNECTION TO REMOTE CHANNELING BD. NAV-750

SIZE C. FLOPPY NUMBER 3-16-0068. REV. SCALE. WEIGHT. SHEET OF

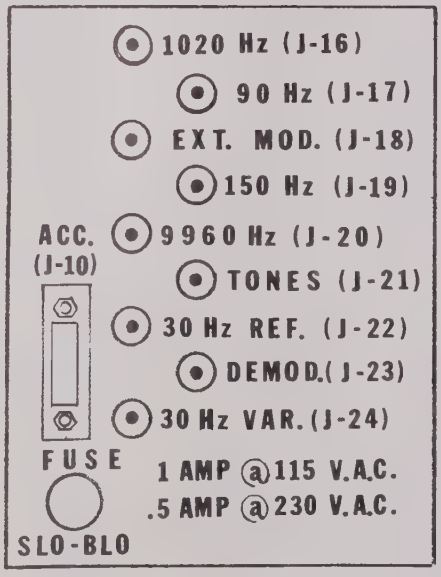


Figure 4-3

List of Connections for Accessory Connector-J10

Pin	Function
1	+24 Volts Regulated Output
2	+12 Volts Regulated Output
3	+5 Volts Regulated Output
4	Ground
5	-12 Volts Regulated Output
6	Remote Channeling Input
7	Ground
8	Ground for external Clock Select
9	External Bearing Clock Input
10	1020Hz Tone Output
11	External Modulation Input
12	End of Channeling
13	NC
14	NC
15	NC
16	NC

FIG. 4-3

Figure 4-4

Correspondence Chart for dB, Volts, Watts into a 50 Ohm Load

dBw - Decibels referenced to one watt
dBm - Decibels referenced to one milliwatt
V - Volts
mV - Millivolts (volts x 10 -3)
uV - Microvolts (volts x 10 -6)
W - Watts
mW - Milliwatts (watts x 10 -3)
uW - Microwatts (watts x 10 -6)
nW - Nanowatts (watts x 10 -9)
pW - Picowatts (watts x 10 -12)
aW - Attowatts (watts x 10 -18)

+40 dBw	709V	10,000W
+39 dBw	633V	7,940W
+38 dBw	563V	6,320W
+37 dBw	501V	5,000W
+36 dBw	447V	3,980W
+35 dBw	399V	3,160W
+34 dBw	355V	2,510W
+33 dBw	317V	2,000W
+32 dBw	282V	1,590W
+31 dBw	252V	1,260W
+30 dBw	224V	1,000W
+29 dBw	200V	794W
+28 dBw	178V	632W
+27 dBw	159V	500W
+26 dBw	141V	398W
+25 dBw	126V	316W
+24 dBw	112V	251W
+23 dBw	100V	200W
+22 dBw	89.1V	159W
+21 dBw	79.5V	126W
+20 dBw	70.9V	100W
+19 dBw	63.3V	79.4W
+18 dBw	56.3V	63.2W
+17 dBw	50.1V	50.0W
+16 dBw	44.7V	39.8W
+15 dBw	39.9V	31.6W
+14 dBw	35.5V	25.1W
+13 dBw	31.7V	20.0W
+12 dBw	28.2V	15.9W
+11 dBw	25.2V	12.6W

+10 dBw = +40 dBm	22.4V	10.0W
+ 9 dBw	20.0V	7.94W
+ 8 dBw	17.8V	6.32W
+ 7 dBw	15.9V	5.00W
+ 6 dBw	14.1V	3.98W
+ 5 dBw	12.6V	3.16W
+ 4 dBw	11.2V	2.51W
+ 3 dBw	10.0V	2.00W
+ 2 dBw	8.91V	1.59W
+ 1 dBw = +31 dBm	7.95V	1.26W
0 dBw = +30 dBm	7.09V	1.00W = 1000mW
+30 dBm = 0 dBw	7.09V	1000mW = 1W
+29 dBm	6.33V	794mW
+28 dBm	5.63V	632mW
+27 dBm	5.01V	500mW
+26 dBm	4.47V	398mW
+25 dBm	3.99V	316mW
+24 dBm	3.55V	251mW
+23 dBm	3.17V	200mW
+22 dBm	2.82V	159mW
+21 dBm	2.52V	126mW
+20 dBm	2.24V	100mW
+19 dBm	2.00V	79.4mW
+18 dBm	1.78V	63.2mW
+17 dBm	1.59V	50.0mW
+16 dBm	1.41V	39.8mW
+15 dBm	1.26V	31.6mW
+14 dBm	1.12V	25.1mW
+13 dBm	1.00V = 1000mV	20.0mW
+12 dBm	891mV	15.9mW
+11 dBm	795mV	12.6mW
+10 dBm	709mV	10.0mW = .01W
+ 9 dBm	633mV	7.94mW
+ 8 dBm	563mV	6.32mW
+ 7 dBm	501mV	5.00mW
+ 6 dBm	447mV	3.98mW
+ 5 dBm	399mV	3.16mW
+ 4 dBm	355mV	2.51mW
+ 3 dBm	317mV	2.00mW
+ 2 dBm	282mV	1.59mW
+ 1 dBm	252mV	1.26mW
0 dBm	224mV = 224,000uV	1.00mW = 1000uW
- 1 dBm	200,000uV	794uW
- 2 dBm	178,000uV	632uW
- 3 dBm	159,000uV	500uW
- 4 dBm	141,000uV	398uW
- 5 dBm	126,000uV	316uW
- 6 dBm	112,000uV	251uW
- 7 dBm	100,000uV	200uW
- 8 dBm	89,100uV	159uW
- 9 dBm	79,500uV	126uW
-10 dBm	70,900uV	100uW

-10 dBm	70,900uV	100uW
-11 dBm	63,300uV	79.4uW
-12 dBm	56,300uV	63.2uW
-13 dBm	50,100uV	50.0uW
-14 dBm	44,700uV	39.8uW
-15 dBm	39,900uV	31.6uW
-16 dBm	35,500uV	25.1uW
-17 dBm	31,700uV	20.0uW
-18 dBm	28,200uV	15.9uW
-19 dBm	25,200uV	12.6uW
-20 dBm	22,400uV	10.0uW
-21 dBm	20,000uV	7.94uW
-22 dBm	17,800uV	6.32uW
-23 dBm	15,900uV	5.00uW
-24 dBm	14,100uV	3.98uW
-25 dBm	12,600uV	3.16uW
-26 dBm	11,200uV	2.51uW
-27 dBm	10,000uV	2.00uW
-28 dBm	8,900uV	1.59uW
-29 dBm	7,950uV	1.26uW
-30 dBm	7,090uV	1.00uW
-31 dBm	6,330uV	.794uW
-32 dBm	5,630uV	.632uW
-33 dBm	5,010uV	.500uW
-34 dBm	4,470uV	.398uW
-35 dBm	3,990uV	.316uW
-36 dBm	3,550uV	.251uW
-37 dBm	3,170uV	.200uW
-38 dBm	2,820uV	.159uW
-39 dBm	2,520uV	.126uW
-40 dBm	2,240uV	.100uW = 100nW
-41 dBm	2,000uV	79.4nW
-42 dBm	1,780uV	63.2nW
-43 dBm	1,590uV	50.0nW
-44 dBm	1,410uV	39.8nW
-45 dBm	1,260uV	31.6nW
-46 dBm	1,120uV	25.1nW
-47 dBm	1,000uV	20.0nW
-48 dBm	891uV	15.9nW
-49 dBm	795uV	12.6nW
-50 dBm	709uV	10.0nW
-51 dBm	633uV	7.94nW
-52 dBm	563uV	6.32nW
-53 dBm	501uV	5.00nW
-54 dBm	447uV	3.98nW
-55 dBm	399uV	3.16nW
-56 dBm	355uV	2.51nW
-57 dBm	317uV	2.00nW
-58 dBm	282uV	1.59nW
-59 dBm	252uV	1.26nW

-60 dBm	224uV	1.00nW
-61 dBm	200uV	0.794nW
-62 dBm	178uV	0.632nW
-63 dBm	159uV	0.500nW
-64 dBm	141uV	0.398nW
-65 dBm	126uV	0.316nW
-66 dBm	112uV	0.251nW
-67 dBm	100uV	0.200nW
-68 dBm	89.1uV	0.159nW
-69 dBm	79.5uV	0.126nW
-70 dBm	70.9uV	0.100nW = 100pW
-70 dBm	70.9uV	100pW
-71 dBm	63.3uV	79.4pW
-72 dBm	56.3uV	63.2pW
-73 dBm	50.1uV	50.0pW
-74 dBm	44.7uV	39.8pW
-75 dBm	39.9uV	31.6pW
-76 dBm	35.5uV	25.1pW
-77 dBm	31.7uV	20.0pW
-78 dBm	28.2uV	15.9pW
-79 dBm	25.2uV	12.6pW
-80 dBm	22.4uV	10.0pW
-81 dBm	20.0uV	7.94pW
-82 dBm	17.8uV	6.32pW
-83 dBm	15.9uV	5.00pW
-84 dBm	14.1uV	3.98pW
-85 dBm	12.6uV	3.16pW
-86 dBm	11.2uV	2.51pW
-87 dBm	10.0uV	2.00pW
-88 dBm	8.91uV	1.59pW
-89 dBn	7.95uV	1.26pW
-90 dBm	7.09uV	1.00pW
-91 dBm	6.33uV	0.794pW
-92 dBm	5.63uV	0.632pW
-93 dBm	5.01uV	0.500pW
-94 dBm	4.47uV	0.398pW
-95 dBm	3.99uV	0.316pW
-96 dBm	3.55uV	0.251pW
-97 dBm	3.17uV	0.200pW
-98 dBm	2.82uV	0.159pW
-99 dBm	2.52uV	0.126pW
-100 dBm	2.24uV	0.100pW

-100 dBm	2.24uV	0.100pW
-101 dBm	2.00uV	0.0794pW
-102 dBm	1.78uV	0.0632pW
-103 dBm	1.59uV	0.0500pW
-104 dBm	1.41uV	0.0398pW
-105 dBm	1.26uV	0.0216pW
-106 dBm	1.12uV	0.0251pW
-107 dBm	1.00uV	0.0200pW
-108 dBm	0.891uV	0.0159pW
-109 dBm	0.795uV	0.0126pW
-110 dBm	0.709uV	0.0100pW = 10,000aW
-111 dBm	0.633uV	7,940aW
-112 dBm	0.563uV	6,320aW
-113 dBm	0.501uV	5,000aW
-114 dBm	0.447uV	3,980aW
-115 dBm	0.399uV	3,160aW
-116 dBm	0.355uV	2,510aW
-117 dBm	0.317uV	2,000aW
-118 dBm	0.282uV	1,590aW
-119 dBm	0.252uV	1,260aW
-120 dBm	0.224uV	1,000aW
-121 dBm	0.200uV	794aW
-122 dBm	0.178uV	632aW
-123 dBm	0.159uV	500aW
-124 dBm	0.141uV	398aW
-125 dBm	0.126uV	316aW
-126 dBm	0.112uV	251aW
-127 dBm	0.100uV	200aW
-128 dBm	0.0891uV	159aW
-129 dBm	0.0795uV	126aW
-130 dBm	0.0709uV	100aW
-131 dBm	0.0633uV	79.4aW
-132 dBm	0.0563uV	63.2aW
-133 dBm	0.0501uV	50.0aW
-134 dBm	0.0447uV	39.8aW
-135 dBm	0.0399uV	31.6aW
-136 dBm	0.0355uV	25.1aW
-137 dBm	0.0317uV	20.0aW
-138 dBm	0.0282uV	15.9aW
-139 dBm	0.0252uV	12.6aW
-140 dBm	0.0224uV	10.0aW

Figure 4-5

Correspondence Chart for 90 and 150Hz Tones

LOC

	DDM	dB	Micro Amps	% Modulations
Centered	0	0	0	20,20
Standard Deflection	.093	4.114	90	15.35,24.65
Full Scale Deflection	.155	7.102	150	12.25,27.75
More than Full Scale	.200	9.542	194	10.00,30.00
Full One Tone, Delete Other	.4	Infinity	387	0.00,40.00

GS

Centered	0	0	0	40,40
Standard Deflection	.091	1.988	78	35.45,44.55
Full Scale Deflection	.175	3.682	150	31.25,48.75
More than Full Scale	.400	9.542	343	20.00,60.00
Full One Tone, Delete Other	.800	Infinity	686	0.00,80.00

DATE	REV	CHANGE	APP'D

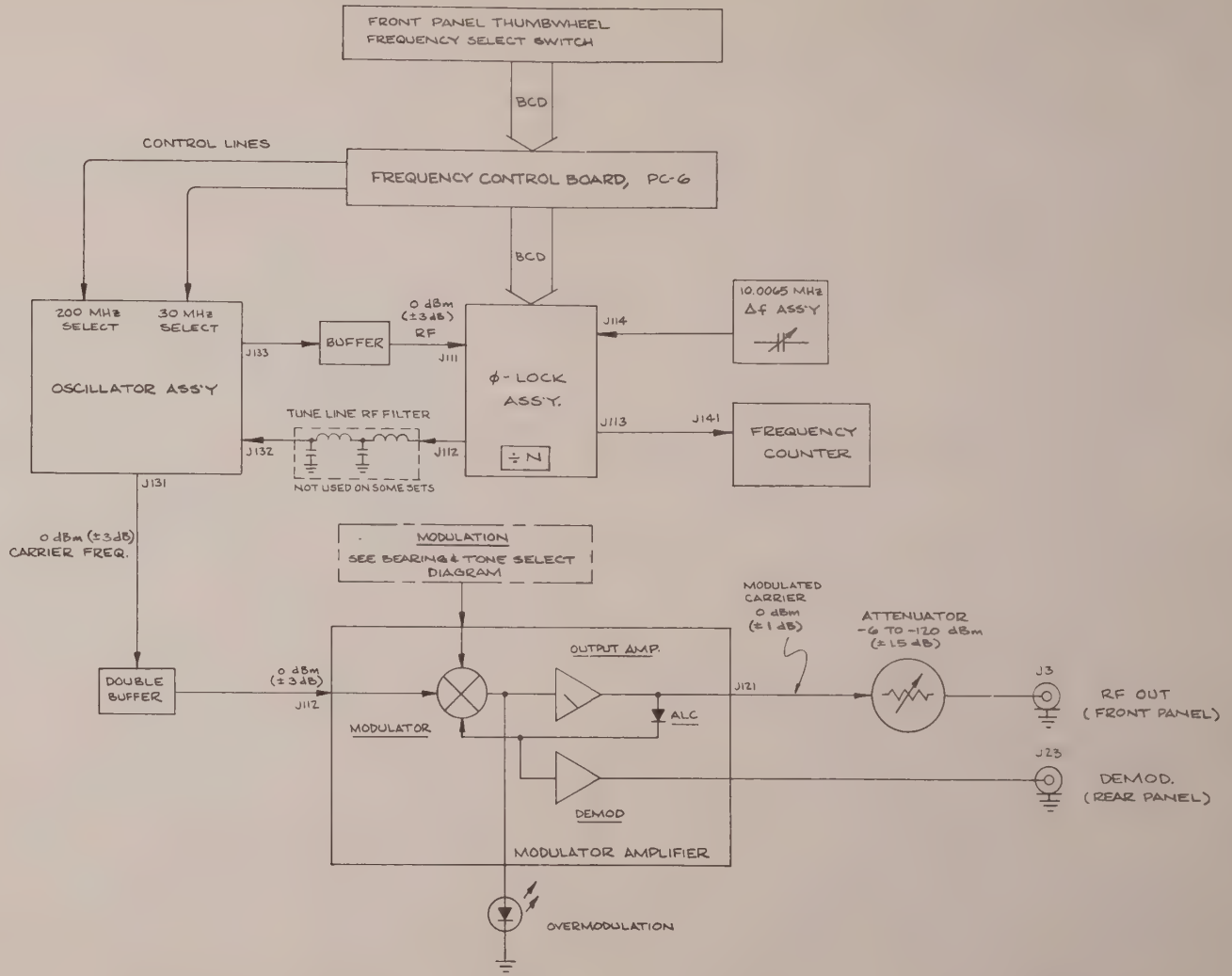


FIG. 4-6

NEXT ASS'Y	QTY	MODEL	ITEM	REQ'D	PART NO	DESCRIPTION
		NAV-750				

APPLICATION — LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS .xx = ± .010 .xxx = ± .005
ANGLES ± 1/2°
FRACTIONS ± 1/64
SURFACE ROUGHNESS 125 ✓
REMOVE ALL BURRS

DRAWN 4 FOR KS 1/2/75
CHECKED CF 1/3/75
APPROVED 1-28-75

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS

TITLE: RF DIAGRAM NAV-750

MATERIAL
TREATMENT
FINISH

SIZE | PART NUMBER 3-16-0226 | REV
SCALE | WEIGHT | SHEET 1 OF 1

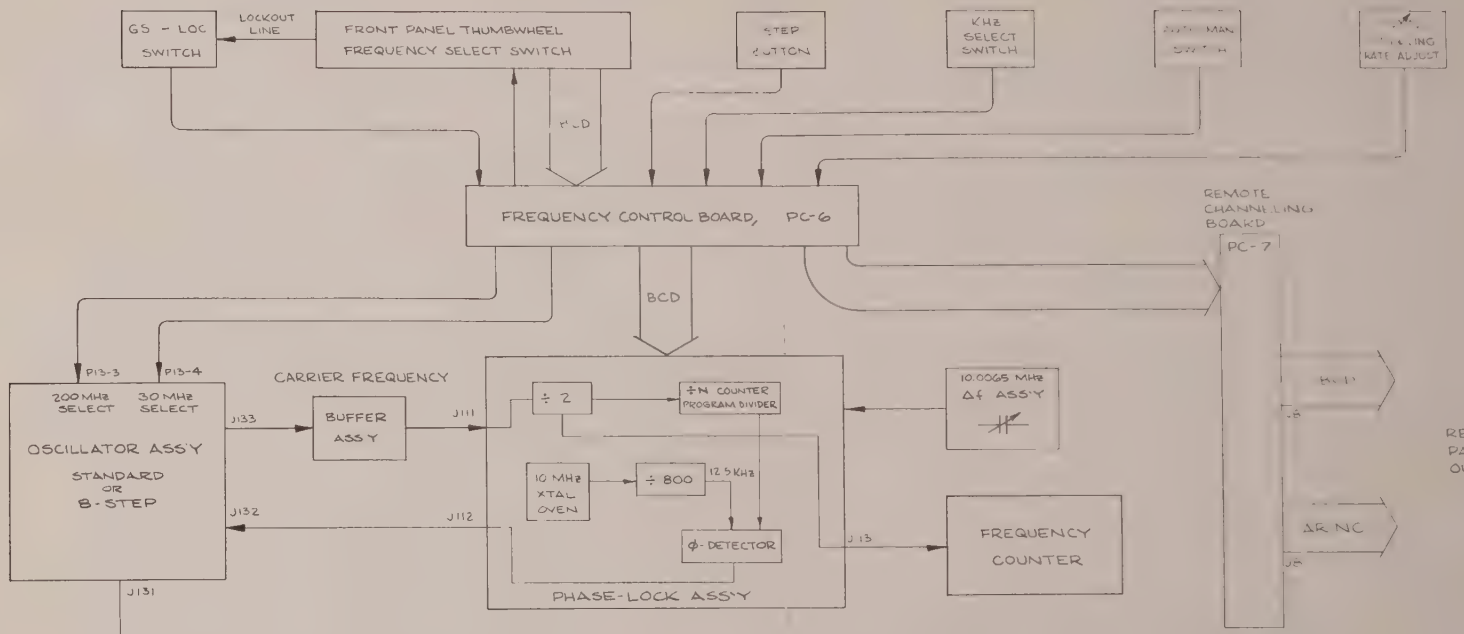


FIG. 4-7

DATE	REV	CHANGE	APPD

NEXT ASSY	QTY	MODEL	ITEM	REQD	PART NO	DESCRIPTION
APPLICATION					LIST OF MATERIALS	

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS .XX = ± .010 .XXX = ± .005
ANGLES ± 1°
FRACTIONS 1/64
SURFACE ROUGHNESS 125
REMOVE ALL BURRS

DRAWN — DATE
CHECKED — DATE
APPROVED — DATE 12 Oct 67

MATERIAL
TREATMENT
FINISH

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA KANSAS

TITLE
RF & FREQUENCY SELECT DIAGRAM
AV-750

SIZE — PART NUMBER 516-0227 — REV
SCALE — WEIGHT — SHEET 1 OF 1

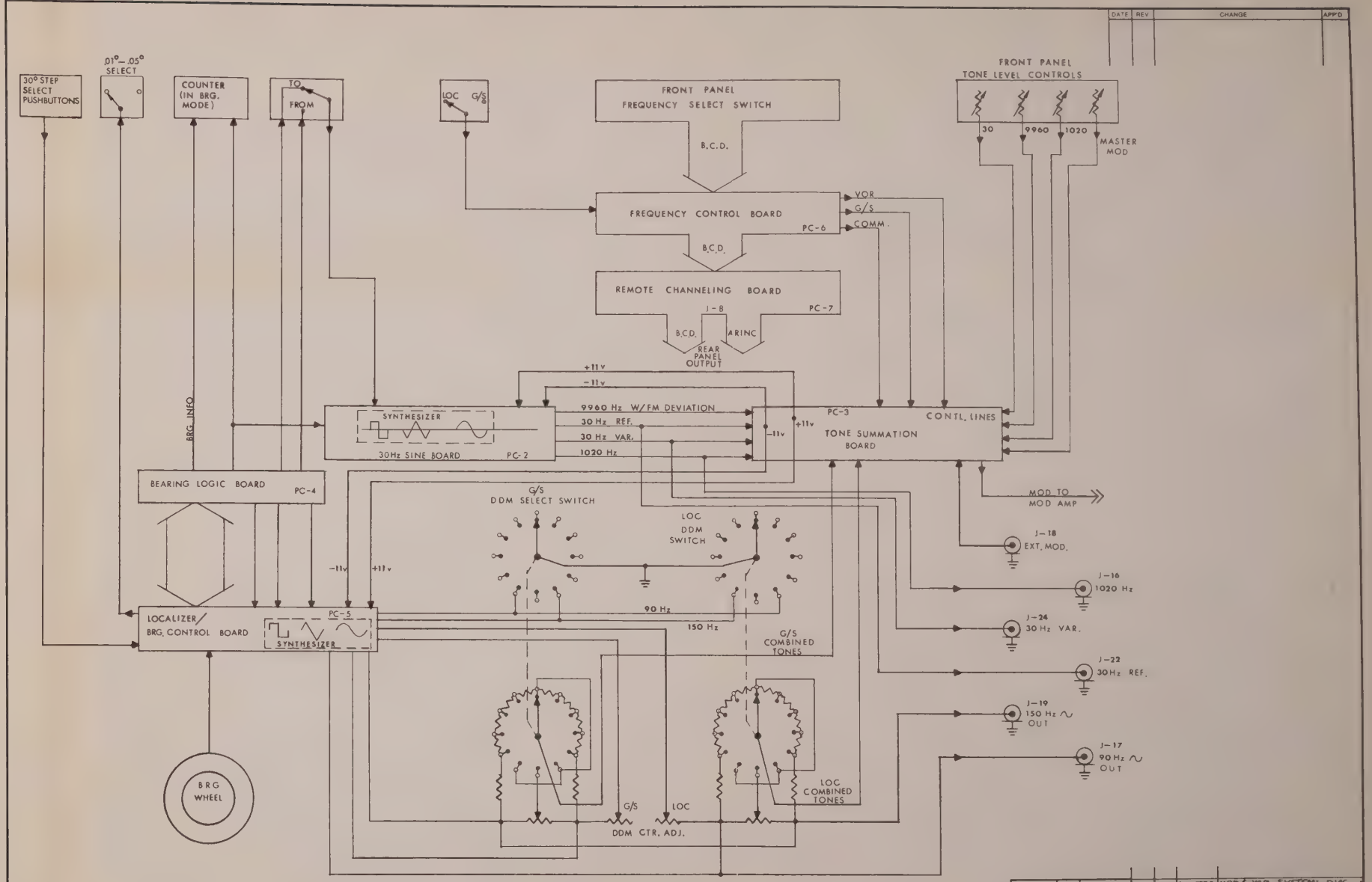


FIG. 4-8

NEXT ASS'Y	QTY	MODEL	ITEM	REQ'D	PART NO	DESCRIPTION
	1	NAV-150	1	1	3-16-0235	MOD & VOR SYSTEMS DIAG.

APPLICATION — LIST OF MATERIALS

TOLERANCES: UNLESS OTHERWISE SPECIFIED ALL DIMENSIONS APPLY AFTER FINISH. DECIMALS xx ± .010 xxx ± .005. ANGLES ± 1°. FRACTIONS ± 1/64. SURFACE ROUGHNESS REMOVE ALL BURRS 125

DRAWN: LD 4/27/65 | CHECKED: [illegible] 4/27/65 | APPROVED: [illegible] 4/29/65

INSTRUMENT FLIGHT RESEARCH CORPORATION, WICHITA KANSAS

TITLE: MODULATION & VOR SYSTEMS DIAGRAM.

MATERIAL | TREATMENT | FINISH

SIZE | PART NUMBER 3-16-0235 | REV

SCALE NONE | WEIGHT | SHEET 1 OF 1

RECEIVER FREQUENCY:	
VOR:	108.00MHz to 111.95MHz, all even tenths (i.e. .20 + .25), of MHz 112.00MHz to 117.95MHz, every 50KHz channels
LOC:	108.10MHz to 111.95MHz, all odd tenths (i.e. .10 + .15) MHz
Glideslope:	329.15MHz to 335.00MHz, every 150KHz channels

DATE	REV	CHANGE	APP'D

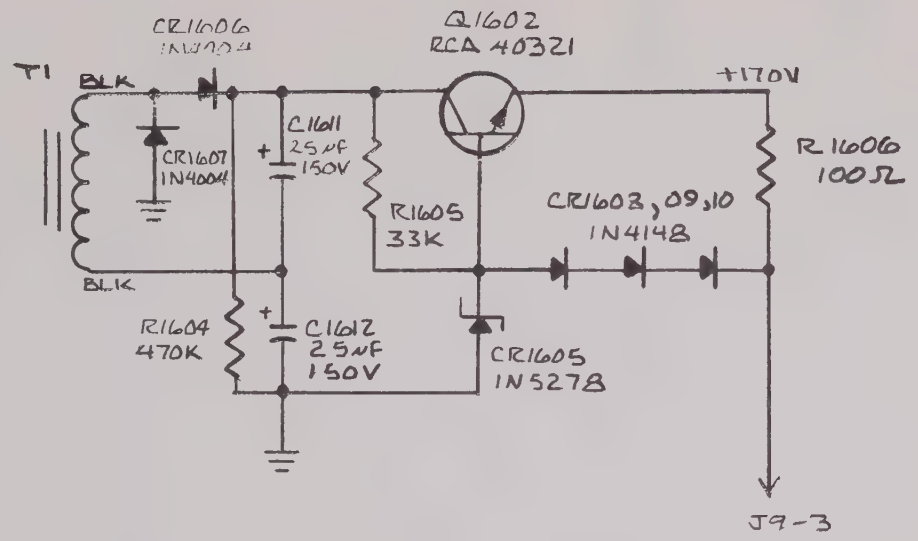


FIG. 9-2

NOTE:

1. REF. ECN #1 OF 3-16-0142A FOR DETAILS OF CHANGES & REASON FOR SEPARATE PRINT OF THIS CKT.

———	—	NAV-760	1	1	1-16-0224	SCHEMATIC
NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	DESCRIPTION

APPLICATION | LIST OF MATERIALS

TOLERANCES
UNLESS OTHERWISE SPECIFIED
ALL DIMENSIONS APPLY AFTER FINISH
DECIMALS: .xx = ± .010 .xxx = ± .005
ANGLES: ± 1/2°
FRACTIONS: ± 1/64
SURFACE ROUGHNESS 125 J
REMOVE ALL BURRS

DRAWN DATE 11-13-74
CHECKED DATE 11-13-74
APPROVED DATE 11-20-74

MATERIAL
TREATMENT
FINISH

INSTRUMENT FLIGHT RESEARCH CORPORATION
WICHITA, KANSAS.

TITLE
H.V. SHORT CIRCUIT PROTECT (SCHEMATIC)

SIZE	PART NUMBER	REV
	1-16-0224	

SCALE | WEIGHT | SHEET 1 OF 1

NAV-750BR

VOR/LOC/COMM AND G/S BENCH TEST SET

(PRELIMINARY)

SUPPLEMENT PART NUMBER: 1-16-501

DATE PRINTED: JULY 1978

NOTE

THESE PAGES SUPPLEMENT THE NAV-750/A/B OPERATION AND MAINTENANCE MANUAL, PART NUMBER 1-23-0373, JULY 1978 PRINTING.

4053 NAVAJO LANE / WICHITA, KANSAS 67210 U.S.A. / (316) 685-9271 / TWX. 910-741-6952

SECTION I-BR

GENERAL DESCRIPTION AND SPECIFICATIONS

1.1 BR GENERAL DESCRIPTION. The NAV-750BR has the same versatility as the NAV-750B. The NAV-750BR RF output is selectable in 1.0 dB steps from -127 dBm to 0 dBm. The output frequency has 100 Hz resolution through the entire frequency range above 107 MHz and maintains the same output spectral purity as the NAV-750B. DDM is selectable in 0.001 steps to 0.400 DDM in the Localizer Modulation Mode and to 0.800 in the Glide Slope Modulation Mode. Modulation percentages are selectable in 0.2% steps over the same ranges. Bearing is selectable in 0.01° steps through 359.99°. Audio modulation of 400, 1020, 1300, and 3000 Hz tones is selectable. Phase deviation between the 90 Hz and 150 Hz tone is selectable as in the NAV-750B.

1.1.1 BR Three card cage boards are replaced in the NAV-750B to make the programmable NAV-750BR. These boards are the Tone Summation Board, the Bearing Logic Board, and the Frequency Control Board. The Z80 Microprocessor Board slides into the former Frequency Control Board slot. Information from the processor is placed in latches on these boards. A ΔF Module is added for increased frequency resolution. The output of the ΔF module is connected to the coax that formerly went to the manual ΔF control on the NAV-750B. A Binary Coded RF Attenuator is added to control the RF output level. The localizer output on the Remote Channeling Board (J8, Pin 7; Figure 8-23) is open in the NAV-750BR test set.

1.2 BR SPECIFICATIONS. The NAV-750BR specifications are identical to those of the NAV-750B (see Section I of basic NAV-750 manual) except as noted below:

ΔF	Range: + 999.9 kHz in 0.1 kHz increments
	Accuracy: Time Base (10 MHz counter)
DDM	Range: 0.001 DDM increments
	Accuracy: ±0.001 DDM plus ±0.3% of selected value of DDM plus centering error
ATTENUATOR	Range: 0 to -127 dBm in 1.0 dB increments
CENTERING ERROR	0.001 DDM

There are no additions to Section II of the basic 750 manual.

SECTION III-BR

OPERATION PROCEDURES
PROGRAMMING

3.Ø BR The NAV-75ØBR is operated by remote programming using the IEEE-488-1975 Interface Bus. The following paragraphs are intended as a guide to programming NAV-75ØBR operation. For additional information on test set operation procedures and theory see Sections III and IV of the basic NAV-75Ø manual.

3.1 BR PRELIMINARY SET-UP. PROGRAMMING. Before operating the NAV-75ØBR through a remote controller, set the Address Switch on the Back Panel of the test set as illustrated in the Primary Listen Address Table (Table I). Disregard the numbers on the switch, which may be reversed or out of sequence. Instead, correlate the switches from left to right with the columns of Table I.

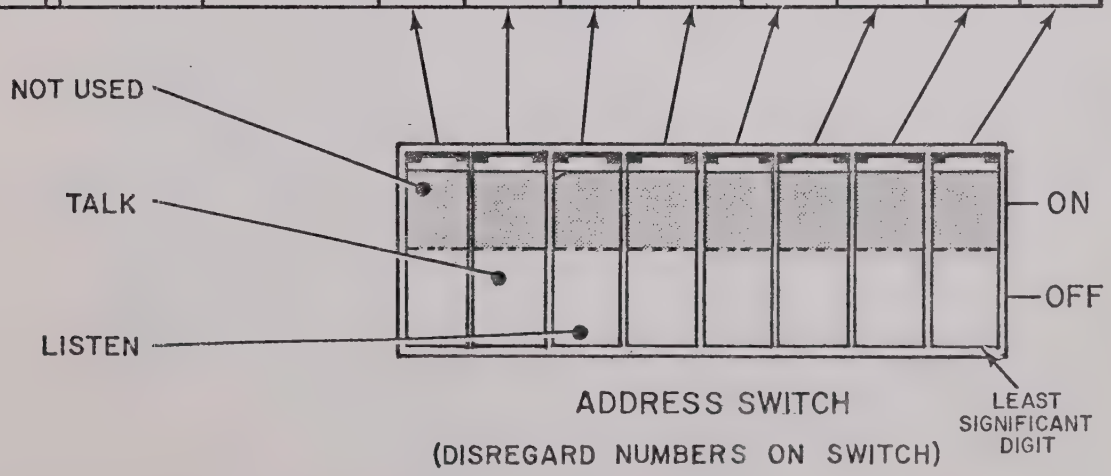
3.1.1 BR The only Secondary Address which will allow the NAV-75ØBR to accept data is the Secondary Address "12", PRINT. If the controller cannot send a Secondary Address "12", then it should not send any Secondary Address.

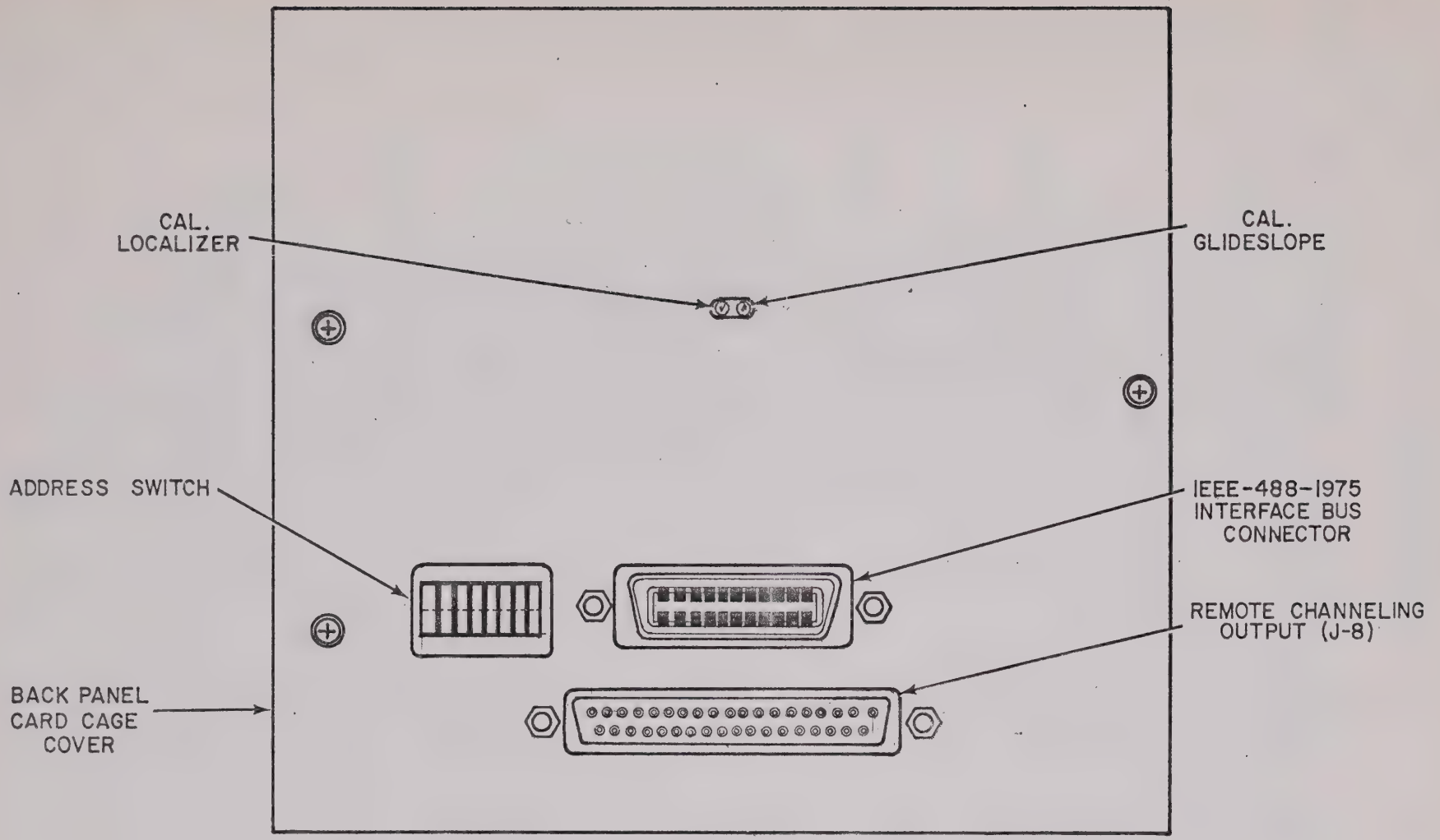
3.1.2 BR An EOI (End Or Identify) must be sent coincident with the last character transmitted to signal the end of the data transmission.

3.1.3 BR The NAV-75ØBR is currently a Listen Only device, able to accept commands from an Interface Bus Controller but with no capabilities for placing data on the Bus. The test set has no polling capability and cannot originate Service Requests (SRQ's). However, when power is first applied to the test set, the SRQ line on the Interface Bus will be active for a very brief time while the test set is being initialized. SRQ is active less than 5Ø µs, which is not long enough to be detected by most controllers. The test set can only be initialized at AC POWER LINE SWITCH ON or by an Interface Clear (IFC) signal from the controller. The Listen Switch of the Address Switch (see Table I) should be in the ON position prior to turning the AC POWER LINE SWITCH ON or sending IFC, if the set is to be addressed as a listener.

OPERATION PROCEDURES PROGRAMMING
PRIMARY LISTEN ADDRESSES
TABLE I

PERIPHERAL DEVICE NUMBER	ASCII VALUE	DECIMAL VALUE	DIO BUS 8	7	6	5	4	3	2	1
Ø	SP	32	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF
1	!	33	OFF	OFF	ON	OFF	OFF	OFF	OFF	ON
2	"	34	OFF	OFF	ON	OFF	OFF	OFF	ON	OFF
3	#	35	OFF	OFF	ON	OFF	OFF	OFF	ON	ON
4	$	36	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF
5	%	37	OFF	OFF	ON	OFF	OFF	ON	OFF	ON
6	&	38	OFF	OFF	ON	OFF	OFF	ON	ON	OFF
7	'	39	OFF	OFF	ON	OFF	OFF	ON	ON	ON
8	(	4Ø	OFF	OFF	ON	OFF	ON	OFF	OFF	OFF
9	)	41	OFF	OFF	ON	OFF	ON	OFF	OFF	ON
1Ø	*	42	OFF	OFF	ON	OFF	ON	OFF	ON	OFF
11	+	43	OFF	OFF	ON	OFF	ON	OFF	ON	ON
12	,	44	OFF	OFF	ON	OFF	ON	ON	OFF	OFF
13	-	45	OFF	OFF	ON	OFF	ON	ON	OFF	ON
14	.	46	OFF	OFF	ON	OFF	ON	ON	ON	OFF
15	/	47	OFF	OFF	ON	OFF	ON	ON	ON	ON
16	Ø	48	OFF	OFF	ON	ON	OFF	OFF	OFF	OFF
17	1	49	OFF	OFF	ON	ON	OFF	OFF	OFF	ON
18	2	5Ø	OFF	OFF	ON	ON	OFF	OFF	ON	OFF
19	3	51	OFF	OFF	ON	ON	OFF	OFF	ON	ON
20	4	52	OFF	OFF	ON	ON	OFF	ON	OFF	OFF
21	5	53	OFF	OFF	ON	ON	OFF	ON	OFF	ON
22	6	54	OFF	OFF	ON	ON	OFF	ON	ON	OFF
23	7	55	OFF	OFF	ON	ON	OFF	ON	ON	ON
24	8	56	OFF	OFF	ON	ON	ON	OFF	OFF	OFF
25	9	57	OFF	OFF	ON	ON	ON	OFF	OFF	ON
26	:	58	OFF	OFF	ON	ON	ON	OFF	ON	OFF
27	;	59	OFF	OFF	ON	ON	ON	OFF	ON	ON
28	<	6Ø	OFF	OFF	ON	ON	ON	ON	OFF	OFF
29	=	61	OFF	OFF	ON	ON	ON	ON	OFF	ON
30	>	62	OFF	OFF	ON	ON	ON	ON	ON	OFF
UNLISTEN		63	OFF	OFF	ON	ON	ON	ON	ON	ON





NAV-750BR BACK PANEL
INTERFACE CONNECTORS & CONTROLS

3.1.4 BR FRONT PANEL SETTINGS. For proper operation the test set Front Panel controls are set in the positions listed below. (The numbers in parentheses after the control name identify its corresponding description in Section III of the basic 750 manual).

1. LOC DDM SELECTOR SWITCH (37).
   - Not in 90 Hz or 150 Hz positions

2. G/S DDM SELECTOR SWITCH (35).
   - Not in 90 Hz or 150 Hz positions

3. TO-FROM BEARING SWITCH (9).
   - In FROM position

4. AC POWER LINE SWITCH (1).
   - ON for ac power

5. ΔF CONTROL (16).
   - In detent OFF position

The following switches may be used as follows:

1. BEARING-FREQ. DISPLAY SWITCH (17).
   - BEARING for VOR bearing monitoring on the BEARING-FREQUENCY DISPLAY (18)
   - FREQ. for output frequency monitoring on the BEARING-FREQUENCY DISPLAY (18)

2. kHz-0.1 kHz FREQUENCY RESOLUTION SWITCH (19).
   - kHz for nearest 100 kHz output frequency monitoring on the BEARING-FREQUENCY DISPLAY (18)
   - 0.1 kHz for nearest 1 kHz output frequency monitoring on the BEARING-FREQUENCY DISPLAY (18)

3. METER FUNCTION SWITCH (12A).
   - BRG or ZERO for bearing check at 90° and 270°
   - RF for monitoring RF output on the panel METER (14)
   - 0-30% or 0-100% for monitoring modulation levels on panel METER (14)

4. BEARING ZERO ADJUST CONTROL (15).
   - To set bearing check circuitry to zero on center scale of panel METER (14)

5. G/S CALIBRATION ADJUSTMENT (36A).
   - is relocated to the Back Panel as a screwdriver adjustment
   - should be moved only for centering adjustments during Calibration Procedures (Section VI). The G/S CALIBRATION ADJUSTMENT is used to precisely match the 9Ø Hz modulation level to the 15Ø Hz modulation level.

6. LOC CALIBRATION ADJUSTMENT (38A).
   - is relocated to the Back Panel as a screwdriver adjustment
   - should be moved only for centering adjustments during Calibration Procedures (Section VI). The LOC CALIBRATION ADJUSTMENT is used to precisely match the 90 Hz modulation level to the 15Ø Hz modulation level.

All other switches and pots are manually inoperative.

3.2 BR MODULATION MODES

1. VOR MODULATION MODE.

   Command Format: V VOR Modulation Mode

   V (ASCII character "V") commands the VOR Modulation Mode in the NAV-75ØBR.

2. LOCALIZER MODULATION MODE.

   Command Format: L Localizer Modulation Mode

   L (ASCII character "L") commands the Localizer Modulation Mode at the value set by the DDM command. (See Paragraph 3.8 BR).

3. GLIDE SLOPE MODULATION MODE.

   Command Format: G Glide Slope Modulation Mode

   G (ASCII character "G") commands the Glide Slope Modulation Mode at the modulation value set by the DDM command. (See Paragraph 3.8 BR).

4. AMPLITUDE MODULATION MODE.

Command Format: AM Amplitude Modulation Mode

AM (ASCII character string "AM") commands the Amplitude Modulation Mode of the NAV-750BR.

3.3 BR TONES

Command Format:			
	T0[1]	YX.X[2]	Select 1020 Hz Tone at YX.X% modulation
	T1	YX.X[2]	Select 400 Hz Tone at YX.X% modulation.
	T2	YX.X[2]	Select 1300 Hz Tone at YX.X% modulation.
	T3	YX.X[2]	Select 3000 Hz Tone at YX.X% modulation.

The ASCII character strings T0, T1, and T3 select the tone frequencies of the various NAV-750BR modulation modes. A range of modulation of 0 to 51.0% is available in 0.2% increments. A percentage entered in an odd numbered tenth will round to the next lower tenth.

Example: 5.3% would read as 5.2%.

3.3.1 BR The Tone Frequency Code (T0[1], T1, T2 or T3) followed by a percentage of modulation figure in the form YX.X (Where Y is an optional digit, and X is required digit) enables the particular tone frequency at YX.X% modulation.

Example: T0[1] 300 enables the 1020 Hz Tone at 30% modulation.

3.3.2 BR VOR MODULATION LEVEL

Command Format:		
	V3YX.X[2]	Set VOR 30 Hz Tone at YX.X% modulation
	V9YX.X[2]	Set VOR 9960 Hz Tone at YX.X% modulation.

The ASCII character strings V3 and V9 set the modulation level of the VOR Modulation Mode (selected using "V") 30 Hz and 9960 Hz Tones, respectively, at YX.X%.

[1]0 = zero

[2]Where Y is an optional digit, and X is a required digit.

3.3.3 BR MASTER GAIN.

Command Format: MG X.XX[2] Master Gain

The Master Gain Control (MG) replaces the MASTER MODULATION LEVEL CONTROL (13) of other NAV-750 models. It is activated through the command "MG" followed by a percentage of modulation figure in the form X.XX[2]. The Master Gain Control setting acts as a multiplier to the percentage modulations of the audio, Glide Slope, and Localizer Tones.

Example: T3 15.2 MG 1.00 modulates the 3000 Hz Tone (T3) at 15.2% (15.2 x 1.00). However, entering MG0.02[1] commands a 0.304% (15.2 x 0.02) modulation of the 3000 Hz Tone.

3.3.4 BR Spaces (blanks) may be entered at any point in the above commands.

3.4 BR FREQUENCY

Command Format: FYXX.XXX[2] Select Frequency of YXX.XXX MHz

To select frequency on the NAV-750BR, enter the ASCII character "F" followed by the desired frequency in the form YXX.XXX MHz (Where Y is an optional digit, and X is a required digit). Frequencies must be in the ranges of 70 to 79.9 MHz, 108 to 156 MHz, or 329 to 335 MHz in 25 kHz increments. The test set may not phase lock on frequencies outside these ranges.

Example: F134.250 programs the NAV-750BR at a frequency of 134.250 MHz.

3.4.1 BR The test set will not acknowledge entries in other than 25 kHz steps. See the ΔF programming information (Paragraph 3.5 BR) for directions on entering 0.1 kHz increments.

[1] 0 = zero

[2] Where Y is an optional digit, and X is a required digit.

3.5 BR ΔF CONTROL.

Command Format:		
DF= YYX.X[2]	Select ΔF YYX.X kHz
DF+	Add YYX.X kHz to Frequency
DF-	Subtract YYX.X kHz from Frequency
DFØ[1]	ΔF OFF

The ΔF frequency is entered by the ASCII character string command "DF=" followed by the desired frequency offset in the form YYX.X kHz (Where Y is an optional digit, and X is a required digit). Thereafter, "DF+" or "DF-" activates the ΔF Module for a positive or negative frequency offset. "DFØ" deactivates the ΔF Module, retaining the "DF=" entry in memory

Example: DF= 123.4 commands a frequency offset of 123.4 kHz. An entry of "DF+" will add 123.4 kHz to the programmed frequency. An entry of "DF-" will subtract 123.4 kHz from the programmed frequency.

3.5.1 BR The ΔF range in the NAV-750BR extends to +999.9 kHz in Ø.1 kHz increments. It is possible to go directly from a positive to a negative ΔF function. Frequency can also be changed while ΔF is activated, retaining the same ΔF value. ΔF should not be used with frequencies below 1Ø7 MHz.

3.5.2 BR The "RØ" and "R" commands (see Paragraph 3.1Ø BR for ΔF quieting) are active in ΔF. Enter "RØ" with "DF" functions to maintain spectral purity in ΔF operation.

3.6 BR BEARING CONTROL.

Command Format:	
BYYX.XX[2]	Select Bearing of YYX.XX°

Bearing is entered with a ASCII character "B" command followed by the desired bearing in the form YYX.XX° (where Y is an optional digit, and X is a required digit). The bearing range of the NAV-750BR is Ø.ØØ° to 359.99° in Ø.Ø1° increments. A bearing entry above 359.99° will read as 359.99°.

[1]Ø = zero

[2]Where Y is an optional digit, and X is a required digit.

3.6 BR BEARING CONTROL. (cont'd)

Example: B26.54 enters a bearing of 26.54°.

3.6.1 BR The TO-FROM BEARING SWITCH (9) on the Front Panel remains active during remote control operation. Ordinarily, the switch remains in the FROM position.

3.6.2 BR The BEARING-FREQ. DISPLAY SWITCH (17) may be manually adjusted to show VOR bearing information on the BEARING-FREQUENCY DISPLAY (18).

3.7 BR RF OUTPUT ATTENUATION.

Command Format: AYYX[2] Attenuation of -YYX dBm

To set the RF output level, enter an ASCII character "A" command followed by a dBm value in the form YYX (where Y is an optional digit, and X is a required digit). The RF output level of the NAV-750BR ranges from -127 dBm to 0 dBm in -1.0 dB steps.

Example: A94 programs the test set at -94 dBm RF output.

3.8 BR DIFFERENCE IN DEPTH OF MODULATION (DDM).

Command Format: DDM.XXX[2]R[1]	Enter .XXX DDM, Right for Localizer Modulation Mode
DDM.XXX[2]L[1]	Enter .XXX DDM, Left for Localizer Modulation Mode
DDM.XXX[2]U[1]	Enter .XXX DDM, Up for Glide Slope Modulation Mode
DDM.XXX[2]D[1]	Enter .XXX DDM, Down for Glide Slope Modulation Mode

To set DDM levels on the NAV-750BR, enter the "DDM" command followed by a DDM figure in the form .XXX[2]. For Localizer Modulation, enter "R" (right) or "L" (left) immediately after the DDM value, and the corresponding DDM will be stored in a Localizer DDM Buffer. For Glide Slope Modulation enter "U" (up) or "D" (down) immediately after the DDM value, and the corresponding DDM will be

[1] "L" (Localizer) or "G" (Glide Slope) modulation mode commands are added to the DDM commands to implement the value in the DDM Buffer.

[2] Where Y is an optional digit, and X is a required digit.

3.8 BR DIFFERENCE IN DEPTH OF MODULATION (cont'd)

stored in a Glide Slope DDM Buffer. "L" (Localizer) or "G" (Glide Slope) modulation mode commands are added to the DDM commands to implement the value in the DDM Buffer. (See Paragraph 3.2 BR). A space (blank) may not be entered between the DDM value (.XXX) and the directional indicator (R,L,U, or D). Additional commands may be entered before the DDM is implemented. However, the "L" or "G" must be entered to implement DDM, even if the test set has been previously operating in that mode.

Example: "DDM .156 R L" enters .156 DDM right and selects Localizer Modulation Mode.

3.9 BR 90 Hz - 150 Hz PHASE DEVIATION

Command Format: P0[1] Activate 90 Hz - 150 Hz Phase Deviation.

P Normal Mode Operation

To activate the 90 Hz - 150 Hz PHASE DEVIATION (29), enter the ASCII character string "P0". The phase relationship between the 90 Hz and 150 Hz Localizer and Glide Slope tones is normally fixed within ±0.1 degrees. For testing purposes, this phase relationship can be varied by retarding the 150 Hz tone relative to the 90 Hz tone 5 degrees for each degree of selected VOR bearing while the P0 is activated.

Example: B10.00P0 will shift the phase relationship between the two tones 50 degrees.

3.9.1 BR To resume normal mode operation, enter the ASCII character "P", which releases "P0".

[1]0 = zero

3.10 BR 10 MHz COUNTER OFF.

Command Format: RØ[1] 10 MHz Reference Counter OFF

R Normal Mode Operation

When making a receiver selectivity test with the NAV-750BR in the ΔF Mode (see Paragraph 3.5 BR), it is sometimes advantageous to eliminate close-in low-level spurs caused by a beat frequency between the ΔF 10 MHz oscillator and the counter time base 10 MHz oscillator. To stop the counter time base oscillator, enter the ASCII character string "RØ". The frequency counter will be disabled until the ASCII character "R" is entered to return it to normal operation.

Example: DF= 123.4 DF+ RØ will deactivate the 10 MHz Counter while a frequency offset of 123.4 kHz is added to the programmed frequency.

3.11 BR CONTROLS.

Code	ASCII	Definition
,	Comma	Execute Immediate
/	Slash	Execute Immediate
(blank)	Space	Delimiter
*	Asterisk	Delete to last EOI in this line

A "," (ASCII Comma) or a "/" (ASCII Slash) are execute immediate commands, loading all Control Register Data into the test set. All commands to the NAV-750BR are stored in a buffer area of memory until a comma or slash is entered.

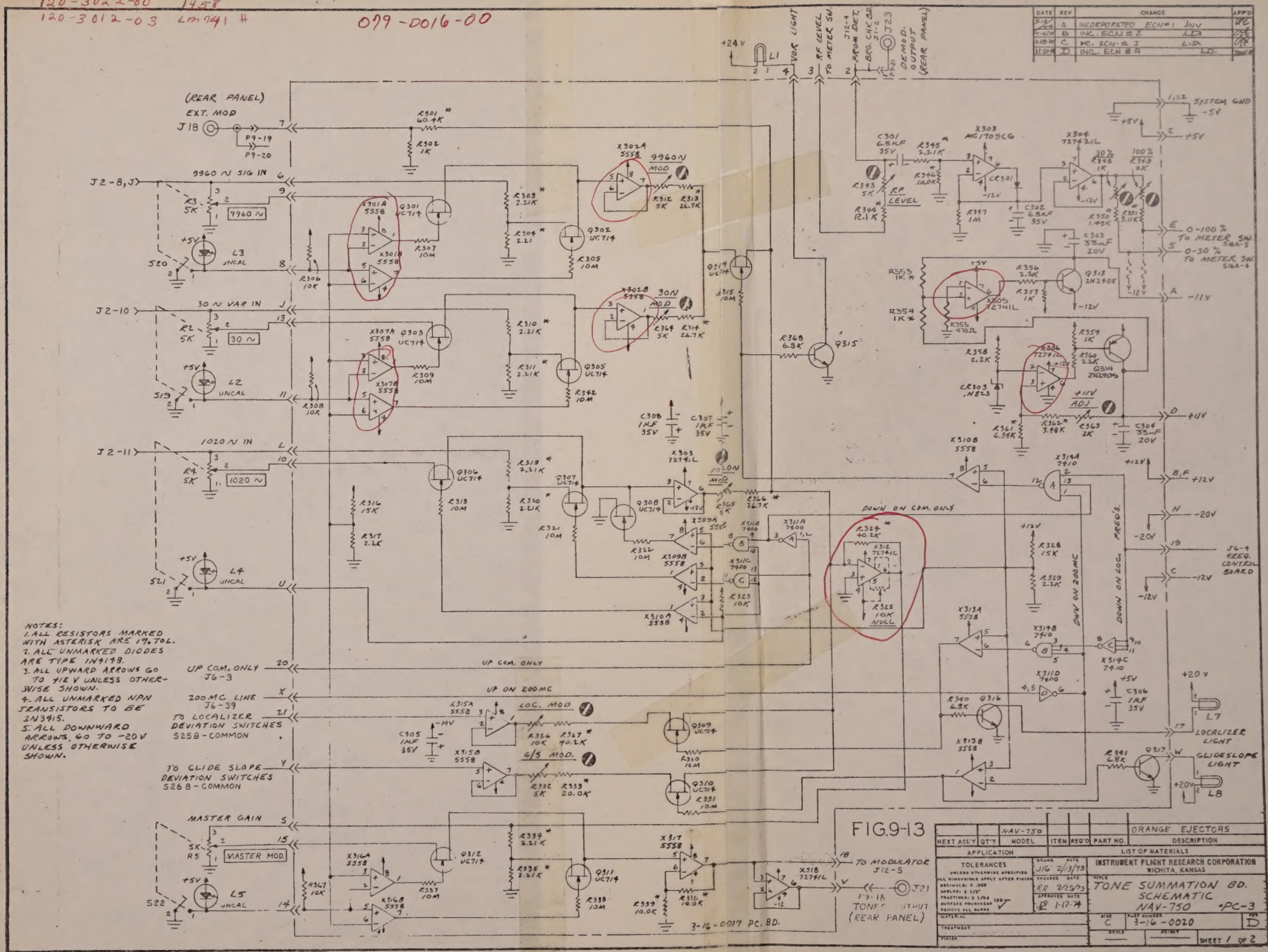
ASCII Space is a delimiter, which may be used to separate commands, except where otherwise specified. An "*" (ASCII Asterisk) deletes all data in the current line back to the last comma, slash, or carriage return. It is often expedient to enter a slash or comma at the end of each command phrase to facilitate deletion and correction.

Example: In the command string "V/F 108.ØØØ/V3 3Ø.Ø/ V9 30.0/MG 9.00*", "MG 9.00" will be deleted. All the other parameters will be immediately entered into the set, and previous correct information does not have to be reentered.

[1] Ø = zero

120-3022-80 1458
120-3012-03 LM1941 #

079-0016-00



NOTES:
1. ALL RESISTORS MARKED WITH ASTERISK ARE 1% TOL.
2. ALL UNMARKED DIODES ARE TYPE 1N4148.
3. ALL UPWARD ARROWS GO TO +15V UNLESS OTHERWISE SHOWN.
4. ALL UNMARKED NPN TRANSISTORS TO BE 2N3915.
5. ALL DOWNWARD ARROWS GO TO -20V UNLESS OTHERWISE SHOWN.

DATE	REV	CHANGE	APP'D
3-16-73	A	INCORPORATED ECN#1	INV
4-12-73	B	INC. ECN # 2	L.D.
4-16-73	C	INC. ECN # 3	L.D.
11-12-73	D	INC. ECN # 4	L.D.

FIG. 9-13

NEXT ASS'Y	QT'Y	MODEL	ITEM	REQ'D	PART NO.	ORANGE EJECTORS DESCRIPTION
APPLICATION						LIST OF MATERIALS

TOLERANCES UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS APPLY AFTER FINISH; DECIMALS: ± .005; ANGLES: ± 1/2°; FRACTIONS: ± 1/64; SURFACE FINISH 125; REMOVE ALL BURRS; MATERIAL; TREATMENT; FINISH

DRAWN JJG 2/13/73; CHECKED RR 2/25/73; APPROVED E 1-17-74

INSTRUMENT FLIGHT RESEARCH CORPORATION WICHITA, KANSAS

TITLE: TONE SUMMATION BD. SCHEMATIC NAV-750 -PC-3

SIZE C; PART NUMBER 3-16-0020; REV D; SCALE; WEIGHT; SHEET 1 OF 2

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